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THURSDAY, APRIL 29, 1920.

The Chemical Industries of German Rhineland.

IN 1916, as a result of war conditions, British chemical manufacturers formed an association with the view of strengthening and consolidating their position by mutual help and co-operation. After the declaration of the armistice the association dispatched a Mission to Germany, under the guidance of the Department of Overseas Trade, to study the present position of German chemical industry. The Mission consisted of twenty members of the association, representing various branches of chemical manufacture, and it was accompanied by a military representative and by delegates of the Department of Overseas Trade, the Board of Trade, the Local Government Board, and Canadian interests. Thirty-nine works were visited, all of them in German Rhineland and in zones occupied by the Allies from north of Cologne to Mannheim. The inquiry resolved itself into a study of the position of the following sections of chemical industry, as developed in Germany, viz. (1) Heavy chemicals; (2) coal-tar products, intermediates, and dyestuffs; (3) fine organic and pharmaceutical products; (4) general inorganic products.

The report of the Mission is of the highest public importance, and merits the attentive consideration of every chemical manufacturer in the kingdom. It is, however, too technical to be dealt with here. We are concerned rather with its general purport and with the lessons and warnings it conveys. These are given in the summary of the report which the association has caused to be printed and published.[1] We trust it will be widely circulated and read. The moral it inculcates is summed up in this one brief sentence: *"German chemical industry has been one stupendous organisation for effecting and promoting the application of science to industry"*—a statement which, we agree with the writer of the summary, "should be displayed, not only in every office, but in every educational institution in the kingdom," as well as "in all Government Departments."

At the same time, there is nothing very new in this pronouncement. It has been the burthen of innumerable articles and public addresses during the last half-century; and we see their effect in the multiplication of our provincial universities and the creation of our various technical colleges and schools. Anyone at all familiar with the history of these institutions knows that their creation has been entirely due to the action of a few public-spirited men who have laboured, in season and out of season, and often under sore discouragement, to effect their establishment. In no single instance have they been due to the spontaneous impulse of a whole community, prompt to recognise and to appreciate the value of science to industry. Even when established, there was, as a rule, no very widespread desire, at all events at the outset, to take advantage of the opportunities they afforded. In most of them their day of small things was a fairly long period.

But the coming of the war brought a great awakening. The national importance of science was recognised as never before. We then realised we were confronted with a nation that had sedulously cultivated science in its application to practically every art and every industry of peace, as well as of war, and we were amazed and disquieted at our own shortcomings and our supine neglect. The new Education Act is a measure of the degree to which the country has been roused. The ease and practical unanimity with which it was passed are the clearest proofs of the public conviction of its necessity.

The document before us, emanating from a body of experts eminently qualified to express an authoritative opinion, will serve to strengthen that conviction. It deals, of course, mainly with only one branch of applied science; but, as it happens, it has been a branch which has rendered extraordinary service to the country at one of the most critical periods of its history. It was not so much our knowledge of chemistry that helped us, or the facilities we possessed of applying it. In these respects we were lamentably behind our chief enemy, and that enemy knew it. But she reckoned without the national characteristics which ultimately saved the situation, and, luckily for us and the world, her lightning stroke missed its aim, and she was compelled by circumstances to give us time to develop and apply them. But it is safe to say that, had we been capable of taking up the position before the war that we were in at its close, its duration would have been greatly curtailed, and it is conceivable, indeed, that it would never have been begun.

The summary of the report, concise as it is, covers more ground than can be dealt with in a single article. We must therefore confine our-

[1] A Summary of the Report of the British Chemical Mission on Chemical Factories in the Occupied Area of Germany. (Association of British Chemical Manufacturers, 166 Piccadilly, W.1.)

selves to a brief statement of the general impressions which the members of the Mission gained concerning the present development of chemical industry in Germany, and its potential future as affected by the war.

To begin with, the Mission was strongly impressed with the evidence of scientific method which appertained to everything relating to the industry, not only to the laboratory and the factory, but also to accountancy, buying and selling, and the management of labour—in fact, to every side of business activity. This result had been achieved by an efficient combination of experts. "The Germans, in fact, have learnt how to use their leaders with utmost effect." It has been the fashion to disparage the originality of the Germans and to point to their lack of inventive power. Whatever may be their failings in these respects, there is no question that it is through their willingness to co-ordinate their efforts that much of their striking success is to be attributed. Moreover, as is pointed out, the chemical industry occupies a high position in Germany, and it can command the services of the best brains in the country. The status of the chemist is such that it is now, at least in the higher positions, one of the best paid of the professions in Germany—far more so than the Law and the Church. How this has been brought about is clearly stated:

"During generations past, unlimited facilities have existed for providing those who wish to become chemists with an education which is nowhere excelled, so that not only is the status of the chemist high, but the man himself, in virtue of his thorough training, is fitted to maintain the high position in which he is placed. Everywhere the chemist is to the fore, and not only are chemists found in the chief administrative positions of the large chemical undertakings, but they frequently control the great organisations characteristic of German industry generally."

The author of the summary has a very definite opinion as to the influence of the German educational system in the universities and the polytechnics in reaching this result, and he contrasts it with our own system of scholarships and bursaries, which he evidently disparages:

"As German education has been carried on without money bribes in the form of scholarships and fellowships, and without competitive examinations, the system has been one of almost complete *Lernfreiheit*. Although it has often been adversely criticised by those unacquainted with its workings, the results belie all such criticism. At least, the student has always worked with a forward outlook; his effort has been to *solve a problem*, not merely to acquire knowledge. The system has been as far removed as possible from that pursued in this country, especially at Oxford; there can be little doubt that it has been a factor of great importance in the development of industry on a scientific basis in Germany."

Now, while there is much that is unquestionably true in this statement, in his desire to decry our own educational system the writer has shown either that he himself is not wholly acquainted with the later development of the German system, so far as it is concerned with chemistry and its industrial application, or that he is guilty of a *suppressio veri*. The German leaders of chemical industry some time ago determined to attract promising chemical students by that very system of "money bribes" which he deprecates, and to endow what are practically fellowships to be held in connection with German university laboratories. In principle there was nothing in this essentially different from our own procedure—except that the aims of the German manufacturers were not quite so altruistic as those of the "pious founders" in our own universities.

The writer of the summary pays a well-deserved compliment to the enterprise, skill, and courage of the men who controlled these vast industrial concerns—their breadth of view and keenness of outlook; their tireless efforts and unfailing perseverance in attacking problems needing years for solution, and for which no early return for the large expenditure involved could be anticipated. Nothing, we are told, appeared to have struck the Mission more than the lavish monetary outlay on laboratories, libraries, and technical staffs. As an example, an account is given of the leading features of the great Bayer works at Leverkusen, one of the most highly organised of the Rhineland factories. We have also a brief statement describing the rapid development of power stations in the Rhine district, especially during the war; and some account of the working of the *Interessen Gemeinschaft* (I.G.), by which the leading chemical firms co-operate so as to secure community of interests. But limits of space preclude any detailed account of the several matters of interest covered by the report. Enough, however, has been written to indicate its importance. Whilst we cannot wholly subscribe to every statement of the writer of the summary, who has been allowed, possibly, too free a hand in interpreting the findings of the report, we can at least testify that he has the courage of his convictions and little hesitation in giving utterance to them.

Man: Past and Present.

Man: Past and Present. By A. H. Keane. Revised, and largely re-written, by A. Hingston Quiggin and A. C. Haddon. Pp. xi+582+xvi plates. (Cambridge: At the University Press, 1920.) Price 36*s.* net.

IT is scarcely necessary to extol the virtues of the late Prof. A. H. Keane's invaluable compilation of data relating to the races of mankind and their customs (see NATURE, June 8, 1899, p. 121), for it has been the *vade mecum* of almost every working ethnologist for more than twenty years. If the authors of the new edition had a task of exceptional difficulty in practically re-writing a work of so encyclopædic a nature they also had a great opportunity. Moreover, Mrs. Hingston Quiggin and Dr. Haddon had exceptional, if not unique, qualifications for making the most of their chance. But they have contented themselves with pouring their new wine into Keane's old bottles. Even so glaring an anachronism as Keane's classification of the races of mankind and the use of the unpardonable term "Caucasian," with many of its unfortunate implications, have been retained. They have made a digest of the modern literature of ethnology that will be extremely useful to the expert, who knows what to select and what to reject, but utterly bewildering to the student and the general reader, who expect some sort of consistency and some leading idea to bind together such vast masses of data as are presented to them in this book. Instead of this they will find an excellent series of extracts from a host of authors without any serious attempt to create a consistent story or to explain the wide discrepancies in their interpretations of the facts.

Although the authors direct attention (pp. 351–53) to the fact that fatal objections have been made to the fashionable speculation of the independent origin of cultures, throughout the rest of the book they ignore this warning and adopt an extreme attitude in flagrant opposition to the doctrine of diffusion. Take, for example, the dogmatic statement on p. 23:—"In fact, we know for certain that such an independent Copper Age was developed not only in the region of the Great Lakes of North America, but also amongst the Bantu peoples of Katanga and other parts of Central Africa": the researches of one of Dr. Haddon's own pupils, Mr. W. J. Perry, have shown this claim to be totally unfounded. Copper was not used in either of these places until immigrants who had already become acquainted with the economic value of the metal elsewhere had made their way into these territories and discovered the new sources of supply.

This sort of fallacy runs through the whole book, and will be a repeated source of confusion to the thoughtful student. What, for example, will he think of the statement on p. 465: "The idea of an independent evolution of Western [European] culture is steadily gaining ground," after reading a hundred pages earlier that the opposite tendency is now strongly asserting itself?

The late Prof. Keane was a strong supporter of the speculation of the independent origin of culture, and at times became almost fanatical in giving expression to his devotion to the fashionable craze. But the authors of the present edition, in spite of their pretence of impartiality, go further than the original author. The latter was not always consistent. While he poured scorn upon the whole theory of the diffusion of culture and quoted with child-like gusto the worst extravagances of Brinton's and J. W. Powell's denials of the possibility of such a spread of civilisation as everyone knows to be happening at the present time, he frankly and fully adopted it as the explanation of the ancient Rhodesian monuments at Zimbabwe. But the authors of the present edition reject Keane's solution of the Zimbabwe problem, and adopt Dr. Randall-MacIver's discredited speculations. Thus we are told that "exploration in 1905 dispelled the romance hitherto connected with the 'temples' and produced evidence to show that they were not earlier in date than the fourteenth or fifteenth centuries [*sic*], and were of native construction" (p. 89). Dr. Haddon does not enlighten his readers as to how the discovery of a piece of medieval *Chinese* pottery in one of the altogether subsidiary buildings at Zimbabwe can prove that the great buildings were built by *negroes* not earlier than the fourteenth century. The discovery of a piece of willow-pattern plate in the foundation of a house at, say, Bristol would not prove that the Roman buildings at Bath were erected by Englishmen in the nineteenth century! Yet this is the sort of argument which is naïvely borrowed by Dr. Haddon, who is well aware of the multitude of data entirely fatal to it.

The authors, in fact, seem to have accepted without discrimination anything that has recently appeared in print, and not tested it in the light of their own knowledge. Thus they have reproduced without comment or criticism some of the least excusable fallacies of current ethnological literature. For example, in their discussion of the origin of Chinese civilisation (p. 207) they confuse race and culture. They are giving the reasons for not deriving the *people* of China from south-western Asia, when they are really discussing the origin of Chinese *civilisation*. Writers

who had compiled the vast mass of data in this book should have had no hesitation in dismissing once for all any suggestion that "the present inhabitants of China are late intruders of south-western Asia" (p. 207). At the same time, they should not have been blind to the fact that there is ample evidence to demonstrate how most of the Chinese customs and beliefs were inspired by events that were occurring in Elam, Sumer, and Turkestan early in the third millennium, the influence of which was gradually transmitted to Shensi by prospectors searching for gold, fresh-water pearls, and jade in the heart of Asia.

But the writers have not understood the meaning of these facts. Nowhere in the book is there so much confusion as in the sections relating to Turkestan. On p. 257 they qualify their acceptance of Prof. Ellsworth Huntington's views by quoting Dr. Peisker's wise warning that "[change of] climate was not the sole or even the main factor" in causing the desolation of Turkestan and Central Asia; yet on p. 263 they seem to forget the need for caution, and attempt to explain the origin of Sumerian civilisation as one of the results of a period of drought in Central Asia. To those who are acquainted with the scientific results of M. de Morgan's "Mission en Perse" it will come as a surprise to be told that "recent archæological discoveries [by which the writers refer to Huntington's desiccation hypothesis] make Sumerian origins a little clearer"! On the contrary, M. Edmond Pottier's report on the earliest painted pottery found by M. de Morgan in Susa proves conclusively that the earliest ceramic ware from Turkestan was directly inspired by Elam. So far from the origin of Sumerian civilisation being explained by discoveries in Turkestan, we now know that the culture of the latter area was derived from the neighbourhood of the Persian Gulf.

These examples serve to illustrate the weakness of the book. While making an encyclopædic compilation of extracts from the most recent writers, the authors have made little attempt to assimilate and co-ordinate the collection of facts. Nor has any attempt been made to link together the data by means of any general idea or principle. The book has been compiled at a time when the facts of ethnology are being illuminated by the brilliant light of a new theory which explains how and why the elements of our common civilisation were spread abroad in ancient times by prospectors searching for pearls and the precious metals. This revolutionary idea in ethnology was propounded by one of Dr. Haddon's pupils, Mr. W. J. Perry. But it is clear from this book that Dr. Haddon has utterly failed to appreciate the new vision in ethnology which his own school has effected.

There is no reference to the Talgai skull, and Sir Baldwin Spencer's assumption that the Tasmanians must have crossed Bass Strait on dry land is accepted without comment. Why people whose ancestors had already crossed Wallace's line by boat could not also have ferried across Bass Strait is not apparent!

The lack of maps and diagrams is a serious defect, and many of the illustrations at the end of the book are far from satisfactory. I think it unfortunate that a book of this character should have been issued at the present moment, for it will give the world outside Cambridge an altogether misleading idea of the nature and quality of the excellent training which the Cambridge School of Anthropology is now providing.

G. ELLIOT SMITH.

Critical Mathematics.

Les Principes de l'Analyse Mathématique: Exposé Historique et Critique. By Prof. Pierre Boutroux. Tome second. Pp. iv+512. (Paris: Librairie Scientifique A. Hermann et Fils, 1919.) Price 20 francs.

THIS second volume of Prof. Boutroux's work contains the outlines of analytical plane and solid geometry, projective geometry, the theory of ordinary complex quantities, infinite series and products, infinitesimal calculus, analytical functions. There are also very brief notices of determinants, groups, aggregates, vectors, elliptic, abelian and fuchsian functions.

On the whole, the volume may be described as a varied and stimulating course likely to interest a competent university student and induce him to follow up one or more of the numerous branches of mathematics to which his attention is directed. Owing to the variety of topics introduced, much of the didactic part of the course is very fragmentary; at the same time, it is elegant and suggestive.

To the teacher, the most interesting part of the volume is the critical and historical matter. The historical sections seem to be admirable in every way—judicious, impartial, and in proper perspective and proportion. Among other things, attention is directed to Fermat's contributions to analytical geometry, some of which, in a measure, anticipated Descartes. At the same time, it is pointed out that, whereas Descartes had in view the ousting of pure geometry by analysis, Fermat, like Newton, remained faithful to the old methods, regarding analysis mainly as an auxiliary. Prof.

Boutroux properly directs attention to the fact that much of Apollonius's "Conics" is essentially analytical, though, of course, there is no algebra, strictly so called. In the sections on function-theory, due reference is made to Méray, who shares in great measure with Weierstrass the credit of laying the foundations of a sound theory of analytical functions. It is fortunate that the great similarity of the work of these two mathematicians did not give rise to bitter polemic; there was at least as much material for it as in the famous Newton-Leibniz controversy.

The author's critical remarks, we fancy, will not meet with such unqualified acceptance. To take one example, he says of Peano's symbolism: "Unfortunately, it is not everyone who can read with facility these combinations of signs, which are often grotesque and repulsive, and unaccompanied by a single word of the vulgar tongue. Moreover, M. Peano's symbolism cannot claim to have made any contribution to the progress of mathematics; it remains a remarkable method of scientific shorthand." As a criticism of the work of Peano and his school, this is distinctly unfair. Anyone who has the patience to become moderately familiar with the notation is bound, we believe, to admit that the alternative is either to produce a text full of ambiguities and tacit assumptions, or else one of intolerable prolixity. The present reviewer has come to this conclusion with very great reluctance; even the Cambridge Press has not succeeded in making the "Principia Mathematica" attractive to the eye; and it is to be feared that the first impression it is likely to produce is that it is the work of a drunken compositor. Probably its use will be mainly, if not wholly, confined to the logical foundations of mathematics; for this purpose we think its value is indisputable. There are other controversial statements scattered about the text; they all deserve careful attention, even if the reader is inclined to disagree with them.

There is one point, of frequent occurrence, against which we feel bound to protest. Prof. Boutroux repeatedly says that such an equation as $x^2+y^2=0$ represents *a point*. This is absolutely untrue; it may be said to represent a point-circle (circle of zero radius), or a pair of isotropic lines, according as we exclude or include complex elements. But no single equation in point-co-ordinates can represent a point; moreover, it is fatal to ignore the degree of the equation. Oddly enough, Halphen makes the same mistake in his memoir on characteristics; he repeatedly gives the name of "a single line" to what is, as a degenerate *quadratic* locus, a double line with two special points (or, exceptionally, one special double point) upon it. Fortunately, this does not affect Halphen's conclusions, the reason (apparently) being that he discusses point-equations and line-equations simultaneously.

We hope that this work will have a good circulation in England; its virtues are precisely those in which our text-books still leave something to be desired: elegance, breadth of view, choice of topics, and regard to historical perspective. G. B. M.

The Proteins.

The Physical Chemistry of the Proteins. By Prof. T. Brailsford Robertson. Pp. xv+483. (London: Longmans, Green, and Co., 1918.) Price 25*s.* net.

THIS is not a new book. It first appeared in the form of an edition in German published at Dresden in 1912. The second edition, in English, has, however, been so completely rewritten as to make it practically a new account of the subject.

There are four parts, of which the first deals with the mode of preparation and estimation and the chemical constitution of proteins; the second with their electro-chemistry; the third with the physical properties of their solutions, such as viscosity, refractive indices, etc.; and the last with what the author calls the chemical dynamics of protein systems, by which, broadly, he means their reactions with catalysts. It will be seen that a complete survey of the subject has been attempted, and it may be said at once that, as an introduction to the literature, already extensive, the book can be commended.

It is now agreed that the proteins are chemically a homogeneous group the molecules of which are built up by the synthesis of amino-acids. The size of the molecules so formed is still open to doubt. Emil Fischer, than whom no one could speak with more authority, refused to accept the molecular weights of 15,000 to 20,000 commonly ascribed to native proteins. The molecular weight, indeed, varies widely from the 16,000 of hæmoglobin, or the 17,000 of edestin, to the values reckoned in hundreds of the polypeptides. It certainly lies in the thousands for native proteins, and is large enough to upset the simpler stoichiometrical relations.

Consider, for example, the reaction with acids and alkalis. Proteins, like amino-acids, are amphoteric—that is to say, they will form salts with either an acid or a base—but, according to the author, when their combining equivalents are determined by known methods, their combining capacity is found to be much in excess of the

possible number of terminal —OH or —COOH groups.

For example, casein, according to the author, behaves as a 16-base acid. To provide sixteen terminal carboxyl groups, the molecule would have to be either a branched chain, or chains radiating from a centre where carbon atoms are directly linked one to another. Such a molecular structure, however, would render the decomposition of the casein molecule on hydrolysis into its constituent amino-acids unintelligible.

Moreover, the form of the molecule of the polypeptides which have been prepared synthetically is not open to doubt, and it is not radial, but a chain, the constituent amino-acids being joined end to end.

The amino-acids of the chain are united by a CONH linkage, which may have a keto- or enol-form, and it is here the author supposes that the reaction with acids or bases takes place.

Consider the simplest case—that of a dipeptide. If combination with an acid or a base takes place at the middle of the chain where the CONH linkage is situated, and the salt ionises in solution, the dipeptide molecule will form two protein ions. Salts of proteins, therefore, should yield, not a protein ion and a simple ion such as $Na^{\cdot}$ or Cl', but two oppositely charged protein ions.

This hypothesis is the central feature of the book, which, indeed, is devoted to following out its consequences. Its validity has been challenged, but, whether true or false, no worker or student will be the worse for learning what it leads to.

Obviously, one consequence is that when a solution of the salt of a protein is electrolysed, the protein should migrate to both cathode and anode. But, as a matter of fact, as Hardy's observations show, the protein migrates only in one direction and in quite a normal way. The author recognises this difficulty and attempts to meet it, but, owing to a slip in the reasoning, his argument would appear to upset his own theory.

Science and Engineering.

Engineering Education: Essays for English. Selected and edited by Prof. Ray Palmer Baker. Pp. ix+185. (New York: John Wiley and Sons, Inc.; London: Chapman and Hall, Ltd., 1919.) Price 6*s.* net.

THIS is an interesting small book containing addresses or portions of addresses by distinguished professors and consulting engineers bearing on the importance of a knowledge of science to engineers. Dr. Steinmetz, of the General Electric Co., urges the need of a broad culture, and especially of the study of Greek and Latin classics, for engineers. Prof. McClenahan, of Princeton University, advocates a three- or four-year course of literary and scientific studies, followed by a two-year technical course. Mr. J. L. Harrington, a well-known engineer and bridge designer, points out the necessity for a thorough knowledge of English.

"It is notorious that a technist is rarely a good business man. This is partly because of the exaggerated importance he gives to technical matters, but very largely because his thought is clumsily expressed and awkwardly ordered."

Mr. Harrington remarks on the frequent obscurity of specifications, and tells of a contractor who never completed a contract without a lawsuit to determine the meaning of a specification, and who had never lost a lawsuit. Sir W. H. White and Prof. Ranum, of Cornell University, write on the value of mathematics. There are addresses on chemistry and physics, and a distinguished consulting engineer, the inventor of the obelisk dam at Niagara, built on end on the shore and then toppled into the river, writes on the importance of imagination.

It strikes a reader that these addresses, each advocating the claim of some one branch of science, interesting as they are, would have been more useful if there had been a recognition of the distinction between what should be included in the school course preceding the technical course, in the technical course itself necessarily restricted, and what extra academic self-education should be expected to accompany and follow it. It may be surmised that engineering students in the United States do not enter on the technical course as well prepared as they should be, and this is certainly to some extent the case here. But preachers on education might remember what Stevenson says of Sainte-Beuve, that he regarded all experience as a single great book in which to study for a few years before we go hence; and it seemed all one to him whether you read in chap. xx., which is the differential calculus, or in chap. xxxix., which is hearing the band play in the gardens.

There is also an admirable address by Sir J. J. Thomson, delivered before the Junior Institution of Engineers, on the relation of pure science to engineering. Sir Joseph remarks that the scientific spirit has not diffused through and influenced the bulk of our industries to the extent it has done in one or two other countries. He traces the evil to the fault of the secondary school, the inefficiency of which causes the technical course to be overloaded.

"The curriculum is founded on the truly British idea that our boys are not expected to learn any-

thing at school. Most of the work in the courses for students in their first year, and some of that in the second, in all the engineering schools with which I am acquainted, is of a kind that a boy might well be expected to do at school. There is no reason why a boy of eighteen, of the mental calibre which would justify his becoming an engineer, should not have a good working knowledge of the calculus and the elementary parts of differential equations, and have read a considerable portion of dynamics. This could, I am convinced, be done without undue specialisation, and without depriving the boy of the literary training which is essential, if he is to keep his sympathies wide and his mind receptive."

W. C. U.

Health and the Teacher.

A Text-book of Hygiene for Training Colleges. By Margaret Avery. Pp. xv+324. (London: Methuen and Co., Ltd., 1919.) Price 7*s.* 6*d.* net.

THIS book is intended to cover the subject-matter of the Board of Education Certificate Examination for Training Colleges in England. It includes the usual anatomico-physiological "properties" long familiar in books of this order since the days of Huxley's "Physiology": elementary ideas about structure of tissues, the skeleton, the muscular system, the circulatory system, the digestive system, etc. But the exposition is kept well within the technicalities suited to the students concerned. There are chapters on food, clothing, cleanliness, mental dullness and deficiency, fatigue, infectious diseases, temperance, school building, medical inspection and treatment, special schools, welfare of infants and young children, legislation affecting school children, and eugenics.

This is a very large programme for so small a book, but the expositions, which, incidentally, retain a good deal of the somewhat loose notes-for-lecture style, are, on the whole, relevant and practical. The author has kept close touch with official memoranda, reports, and standard books. The result is that the volume, all through, contains good informational material which has obviously stood the test of experience in the class-room.

It is difficult to say how much medical information proper should be included in a book like this, but to untrained lay persons it is of no value to state that, in anæmia, "a little iron often has excellent results" (p. 42). Again, as to the cause of rickets, something more is wanted than that "the cause is wrong food, chiefly lack of fat, a lack existing in all patent foods" (p. 88). This kind of information may fulfil the terms of a syllabus, but it is of no value whatever to the student, though, usually, in a practical curriculum, there are many opportunities of supplementing these generalities by demonstrations of cases.

The chapter on "First Aid" relies on accepted instructions, but Schäfer's method for recovery from drowning should have a place. The chapters on legislation affecting children and on eugenics are judiciously proportioned, but the remarks on the causes of pauperism as implying "a want of grit and independence" (p. 305), and on feeble-mindedness and heredity, show that the author has accepted somewhat too uncritically the theoretical deductions of "experts." The book will, however, serve as a good text-book for the practical teacher.

Our Bookshelf.

The Mineralogy of the Rarer Metals: A Handbook for Prospectors. By Edward Cahen and William Ord Wootton. With a foreword by F. W. Harbord. Second edition, revised by Edward Cahen. Pp. xxxii+246. (London: Charles Griffin and Co., Ltd., 1920.) Price 10*s.* 6*d.*

THIS book is neatly bound, and is of handy size for the pocket. The mineral descriptions are conveniently treated in a general way in the alphabetical order of the metals. The alkali metals come first; then follow beryllium, cerium, and so on to zirconium. Under each metal the properties, preparation, industrial application, and ores are first considered; following this an account of the chemical methods for its detection, and a list of the minerals containing the metal, are given. Much care appears to have been taken in describing the chemical and physical character of the minerals and the tests available for purposes of identification. Separate sections at the end of the book deal with the geographical distribution of rare metals and methods of analysis.

To the critical reader of the book many of its features suggest questions and scope for improvement. Is it permissible to regard titanium as a rare metal? Ilmenite is certainly not a rare mineral, and it is incorrect to refer to this mineral as "a chief constituent of monazite from Travancore and Ceylon" (p. 130). It would be more correct to say that the chief producer of rutile is Virginia, U.S.A., than to imply, as the author does, that the chief producer is Norway (p. 131). Under tungsten no mention is made of the wolframite deposits in China, which has recently been the leading producer (p. 141). Zircon is mentioned as occurring in "Scotland and Ireland," but no mention is made of its universal distribution in sands and gravels such as those of Hampstead Heath (pp. 182, 189).

The section dealing with geographical distribution has been revised, but it might with advantage be amplified to include such countries as Spain,

Portugal, and France, where there are many occurrences of greater importance than some that receive mention in this book. T. C.

A Text-book on Machine Drawing for Electrical Engineers. By E. Blythe. (The Cambridge Technical Series.) Pp. vii+81. (Cambridge: At the University Press, 1920.) Price 20*s.* net.

ALL teachers of electrical engineering are aware of the need for a text-book on the drawing and construction of electrical apparatus. This attempt, however, to supply the need is disappointing. Apparently the author intends the book to serve for a complete course of machine drawing for electrical students, for he commences with the laws of projection and gives several very simple examples in illustration of them. He proceeds then to fastenings, cable sockets, junction-boxes, switches, and dynamos. The subject-matter is confined entirely to such apparatus as is found in small continuous-current power stations (but instruments are not included); consequently the alternator, induction motor, oil-switch, and other important pieces of electrical apparatus are notably absent. Several complete plates are devoted to non-dimensioned sketches showing types of apparatus, *e.g.* one on brush-holders; a few such examples are undoubtedly useful for practice in sketching, but here too much space is occupied in this way. The drawings are clear and very well arranged, but the descriptive matter is unnecessarily prolix. The examples given do not always represent good practice; for instance, in several places a single-piece armature disc is shown with a dove-tailed key, while a bearing is shown on p. 73 which would be destroyed by a little end-thrust. The book is well got up and has been prepared carefully; but the ground covered is insufficient—at the price.

Mathematics for Engineers. Part ii. By W. N. Rose. (The Directly Useful Technical Series.) Pp. xiv+419. (London: Chapman and Hall, Ltd., 1920.) Price 13*s.* 6*d.* net.

PART ii. of this book is devoted principally to the differential and integral calculus, and includes chapters on spherical trigonometry and mathematical probability. The book is intended for engineers, most of whom are not called upon in their profession to show capacity for high mathematical flights, but are expected to comprehend clearly such fundamental principles as enter into their work, and to be ready successfully to apply them to practical problems. Examining the book from this point of view, we believe that it will find favour with most engineers and students of engineering. If we include also the matter comprised in Part i. the volumes contain practically everything in the way of mathematical principles which the engineer is likely to require. The treatment is clear and of a kind which appeals to engineers, and a very large number of practical applications are given. Many of these are fully worked out to the arithmetical result, and there are very few which can be said to be of an academical nature only. These examples cover a wide field, having been drawn from all branches of engineeering, and represent a large amount of labour for which engineers will be grateful. We can heartily recommend this volume, as well as its predecessor, to all students of engineering.

The Manufacture of Intermediate Products for Dyes. By Dr. J. C. Cain. Second edition. Pp. xi+273. (London: Macmillan and Co., Ltd., 1919.) Price 10*s.* net.

PROBABLY no one in this country is more competent to write on intermediate products than Dr. Cain, and the fact that a new edition of this book has been called for within a year is the best testimony to its success. The opportunity has been taken to improve certain sections and to incorporate new work, most of which, it is of interest to note, originates now in America. It is gradually being realised that intermediates are the crux of the dye situation, and the wisdom of the policy adopted in this direction by British Dyes, Ltd., in building their new factory at Huddersfield is becoming apparent. Given the intermediates, the manufacture of the several dyes is usually a fairly straightforward problem, but there is still much leeway to make up in connection with intermediates, which will require the most ample resources, alike in capital, plant, and technical experience. This will take considerable time to fructify, and some form of closer co-operation with the heavy chemical trade would appear most desirable.

The British colour industry is receiving some adverse criticism from the users of the rarer colours for which the demand, at the most, is but small, but it has a more important task at the moment than to fritter away its energies in making these colours. The colour industry is based on intermediates; it is the manufacture of these by the best methods, with the largest yields, and of satisfactory purity which must be studied in the laboratory and in the works. This is being done, and Dr. Cain, through his book, in which the available information is clearly presented, is helping to do it.

Solutions of the Examples in a Treatise on Differential Equations. By Prof. A. R. Forsyth. Pp. 249. (London: Macmillan and Co., Ltd., 1918.) Price 10*s.* net.

EVEN from the point of view of an undergraduate, the subject of differential equations is very different from what it was fifty years ago. But in a large and miscellaneous collection of examples like this there are a number of survivals which remind us of De Morgan's application of the proverb: "Those that hide know where to find." Teachers and solitary students (if such there be nowadays) will be grateful to Prof. Forsyth for providing them with a key. It is one more example of the author's untiring industry and, so far as we have tested it, of his accuracy in details of analysis. M.

Letters to the Editor.

[The Editor does not hold himself responsible for opinions expressed by his correspondents. Neither can he undertake to return, or to correspond with the writers of, rejected manuscripts intended for this or any other part of NATURE. *No notice is taken of anonymous communications.]*

Theories of Atomic Structure.

IN a letter to NATURE (March 11, p. 41) S. C. Bradford stated: "The great objection to Langmuir's theory of atomic structure is the difficulty of accepting his hypothesis of stationary electrons." The cases cited are all discussed in G. N. Lewis's paper, "The Atom and the Molecule" (Journ. Amer. Chem. Soc., xxxviii., p. 762, April, 1916), so it is scarcely fair to Lewis to refer to the theory as "Langmuir's theory."

Although Lewis frankly implied that the electrons in atoms are stationary, his theory of valency did not depend upon such an assumption. The chemical data give information in regard to the geometry of atoms, and, in particular, tell us of the kinds of symmetry which they possess. From the chemical point of view it is at present a matter of comparative indifference what the motions of the electrons may be so long as they conform to the required conditions of symmetry. For this reason I was careful to state in my first paper (Journ. Franklin Inst., clxxxvii., p. 359, March, 1919, and Journ. Amer. Chem. Soc., xli., p. 932, 1919) that "the electrons in atoms are either stationary *or rotate, revolve, or oscillate about definite positions in the atom.*" It was, perhaps, not sufficiently emphasised that the positions of the electrons shown in the diagrams may be regarded as the centres of their orbits.

It is sometimes thought that the success of Bohr's theory furnishes reason for believing that all the electrons in atoms are rotating in coplanar orbits about the nucleus. There is little justification for this opinion. The remarkable results yielded by Bohr's theory, particularly in the hands of Sommerfeld, for the case of the hydrogen atom and the helium ion seem to prove beyond question that in an atom containing only one electron this electron actually revolves in a circular or elliptical orbit about the nucleus. Although Bohr's theory has had some applications to other atoms, these are, for the most part, of a very general nature, such as those which relate to the combination principle. The theory does not give a satisfactory model even for such simple structures as the hydrogen molecule or helium atom (see, for example, Sommerfeld's recent book, "Atombau und Spectrallinien").

From the chemical point of view Bohr's theory is wholly unsatisfactory when applied to atoms containing more than one electron. Thus, according to Bohr's calculations (*Phil. Mag.*, xxvi., p. 492, 1913), a lithium nucleus surrounded by three equidistant electrons should have less potential energy (and, therefore, greater stability) than one in which one electron is further from the nucleus than the other two. Bohr's theory thus gives no reason for the contrast between the properties of lithium and helium.

The two theories are not mutually incompatible if we consider that, in general, the electrons do not revolve about the nucleus, but about definite positions symmetrically distributed in three dimensions with respect to the nucleus. It is interesting to note that Born and Landé (*Verh. deut. physik. Ges.*, xx., pp. 210, 230, 1918), starting out from Bohr's theory and without knowledge of Lewis's work, were led to the theory of the cubical atom by a study of the compressibilities of the alkali halides. They conclude that the electron orbits do not lie in a plane, but are arranged in space with cubic symmetry. Sommerfeld in his book suggests that this conception may help to solve some of the outstanding difficulties, and evidently does not consider it inconsistent with Bohr's theory.

In the case of atoms which do not share electrons with other atoms, it is logical to assume that each electron in the outer shell has its own orbit. Thus the atoms Ne, Na^+, Mg^{++}, F^-, and the S atom in SF_6 should have cubic symmetry, the eight outer electrons revolving about positions located at the corners of a cube. But where a pair of electrons is held in common between two atoms, the chemical evidence indicates that the pair acts as a unit. When an atom shares four pairs of electrons with its neighbours, it thus has tetrahedral rather than cubic symmetry. So far as the chemical evidence is concerned, it would be satisfactory to adopt Bohr's model for the hydrogen molecule to represent the pair of electrons which constitutes the chemical bond. We may thus picture the chemical bond as a pair of electrons revolving in a single orbit about the line connecting the centres of the two atoms.

Bohr in his 1913 paper (*Phil. Mag.*, xxvi., p. 874) states: "The configuration suggested by the theory for a molecule of CH_4 is of the ordinary tetrahedron type; the carbon nucleus surrounded by a very small ring of two electrons being situated in the centre, and a hydrogen nucleus in every corner. The chemical bonds are represented by four rings of two electrons each rotating round the lines connecting the centre and the corners." This structure is quite consistent with the octet theory. Bohr did not, in general, identify a pair of electrons with a valency bond.

When we consider, however, that Bohr's theory in its present form does not furnish an explanation of the stability of the pair of electrons in the helium atom and in the bond between atoms, it is evident that the model described above can scarcely be regarded as satisfactory. It seems as though some factor of vital importance is still missing in Bohr's theory. The chemical data suggest that the ultimate theory will be extremely simple, but perhaps more radical than anything yet proposed.

I am in full agreement with the views put forward by Dr. H. S. Allen in NATURE for March 18, p. 71.

IRVING LANGMUIR.
Research Laboratory, General Electric Co.,
Schenectady, New York, April 12.

Decimal Coinage.

IN NATURE of April 1, p. 145, reference is made to the unfavourable report of the Royal Commission appointed to inquire into the above subject. It would appear from a close study of the findings of the Commission that the failure to solve this century-old problem was due more to differences between the advocates than to opposition to the principle.

Although fifteen of the twenty Commissioners would prefer to decimalise the existing £ sterling rather than to create a new monetary unit equal to 100 halfpence, it is significant that only four of them could agree that the advantages to be secured by the decimalisation of the £ would outweigh the inconvenience arising from the change. This is tantamount to an admission that the method of dealing with the penny difficulty as proposed in Lord Southwark's Bill (£—mil) was unduly complicated. (No exact equivalent of the penny was provided, the choice of a 4-mil and 5-mil piece being alternatively offered.)

Retaining the £ as the unit, there are three possible values for the penny, viz.:

4 mils = the present penny less 4 per cent.
5 mils = the present penny *plus* 20 per cent.
4⅛ mils = the present penny exactly.

The claims of these denominations may be summed up as follows:

The 4-mil Penny.—As the denomination 4 represents neither a decimal multiple of 1 nor a binary division of 10, a 4-mil coin could have no permanent place in any decimal coinage system. As a transitional value it would also be unattractive, because it would still further reduce the purchasing power of the penny at a time when an increase is needed, and its temporary adoption would involve two adjustments of existing pennyworths, thus doubling, instead of removing, the difficulty. For these and other reasons a 4-mil penny may be safely dismissed from our consideration.

The 5-mil Penny.—There are at least four good reasons in its favour, viz.:

(1) In a decimal coinage system prices are normally arranged in steps of 5, *e.g.* 5, 10, 15, 20, 25, etc., and the value of 5 mils would fall conveniently between that of the unduly high 5 American cents and the unnecessarily low 5 centimes of the Latin Union.

(2) The reduction of the present high prices would be hastened by the provision of a penny of this value. The price of a pre-war pennyworth, now sold at three-halfpence, could obviously be reduced to 5 mils long before it could be restored, if ever, to the original penny.

(3) The prevailing shortage of copper coins would be relieved by thus increasing the token values of all the penny and halfpenny coins now in circulation. Two copper coins are now employed in countless transactions where formerly one sufficed, and this fact alone, quite apart from decimalisation, demands a penny of higher value.

(4) The simple relationship of 10 pence to the shilling would be readily grasped by the uneducated, and the deservedly popular single-coin payments would be restored. Retail shopkeepers could, if so desired, continue to keep their accounts in £ *s. d.* instead of £ *f. m.*, the 2½, 5, 10, and 25 mil coins being in that case entered as ½, 1, 2, and 5 pence, all the higher value coins retaining their present descriptions as 1, 2, 5, and 10 shillings respectively.

Note.—The majority Commissioners apparently feared that 5 mils would always be charged in place of the present penny. If they had said in place of the present three-halfpence, they would have been just as near the truth, which possibly lies between these two views. Probably everyone would now be very glad to pay 5 mils for a pre-war pennyworth of anything—the trouble is we are charged three-halfpence or more. When introducing this year's Budget the Chancellor of the Exchequer (referring to his proposal to raise the receipt duties from 1*d.* to 2*d.*) said: "This change is no more than reflecting the altered value of the penny."

The 4½-mil Penny.—If there are insuperable difficulties in the way of raising the values of the existing penny and halfpenny coins to make them serve as tokens for 5 mils and 2½ mils respectively, they could remain in circulation at their present values side by side with new 5-mil nickel coins, in which event their values in mils could be expressed as 4–2 and 2–1 respectively, the latter figure representing twelfths of a mil. (These expressions would be no worse than our present use of 4/2 to represent four shillings and two-twelfths.)

The present penny could thus be preserved indefinitely for the continued exact payment of all statutory pennyworths, but the competition of the smaller, lighter, and cleaner 5-mil nickel coin, representing a value in closer harmony with present-day needs, would rapidly drive the bronze penny out of popular favour for the countless single-coin payments of daily life. In concluding that this method might involve the dual circulation of pence and mils "for seventy-five years or more," the majority Commissioners have unwarrantably assumed that no steps would be taken by the established "penny" interests, such as insurance and tramway authorities, etc., to bring themselves into line with the new mil system, whereas many of these interests are already agitating for legislative authority to abandon the penny basis, which has proved inadequate to cover operating costs. Many of the old fixed penny charges, such as the penny stamp, penny-a-mile, etc., have already disappeared, and the retention of the coin itself is no longer a matter of vital importance.

The £ sterling could thus be decimalised either without altering the penny or by raising its value to 5 mils (either instantaneously or gradually), and so securing substantial benefits over and above those normally arising from decimalisation.

Having very truly said: "It is necessary to distinguish between the coins in circulation and the reckoning of money of account," and having properly referred to the human habit of halving quantities, the Commissioners failed to realise that it is quite practicable to combine the advantages of decimal accounts and binary coins. Such a composite scheme would provide decimal multiples and binary divisions thus:

Coins	In accounts			Equivalent		
	£	*f.*	*m.*	£	*s.*	*d.*
Gold or Note:						
Pound	1	0	00	1	0	0
Half-pound		5	00		10	0
Quarter-pound (crown)		2	50		5	0
Silver:						
Florin		1	00		2	0
Half-florin (shilling)			50		1	0
Quarter-florin			25			6
Nickel:						
Dime (10-mil piece)			10			2·4
Bronze:						
Half-dime (penny)			5			1·2
Quarter-dime (halfpenny) ...			2½			0·6
Mil			1			0·24

The above proposal achieves the complete decimalisation of the £ by means of a smaller number of coins and in a simpler manner than by the method described in Lord Southwark's Bill. No decimal point would be needed, the number of figures would be reduced, and no new coins would be immediately required.

HARRY ALLCOCK.

Trafford Park, Manchester, April 21.

International Council for Fishery Investigations.

As the writer of the article on the above subject in NATURE of March 18, I should be disposed to allow Prof. McIntosh's letter in the issue of April 8 based on it to pass without comment if that letter had not been quoted extensively elsewhere. I merely remark that the professor's claim to maintain the same position as he took up in his published criticisms in 1902 and 1903 is fully substantiated. I see no reference in my article to the Moray Firth, which, indeed, had nothing to do with the International Council, and which I must leave Prof. McIntosh to settle with his fishery colleagues in Scotland. His criticism of the representatives of France is out of place, in that representatives of all countries are appointed by their Governments.

Prof. McIntosh confuses the programme adopted with the general discussion which took place first. Commodore Drechsel and others spoke of "the closure of the greater part of the North Sea as the most gigantic scientific experiment ever made [will

any scientific man contest this view?] in respect to the closure of areas." This is stated by Prof. McIntosh to be the first item in the scheme of investigations, whereas no such general scientific investigation is recommended. Whether or not the fisheries of the North Sea will be permanently altered by the closure consequent on the war no one knows, but certainly trawlers have been experiencing the immediate benefit of the closure since the armistice. The extent to which the North Sea is covered by the operations of trawlers is evidently not understood. The work of Masterman, Heincke, and others results in the estimate that 1500 million plaice of more than 12 cm. live in the North Sea, of which one-third are caught annually, 200 million being put on the market and 300 million being destroyed in the process of catching.

Again, Prof. McIntosh refers to one part only of the proposal for the protection of plaice, viz. that by a size limit, whereas the permanent closure of certain areas "to provide a reserve from which the young plaice might spread so as to restock the open grounds" is definitely mentioned in my article. Prof. McIntosh apparently does not realise that the representatives of at least three of the four countries that are particularly interested in the plaice stock of the North Sea are convinced that the evidence shows that the plaice stock is, under normal conditions, being so seriously depleted by man that international legislative action is essential. In view of such action, the proposed year's intensive plaice investigation is fully justified. We wonder whether Prof. McIntosh has examined the statistics that have been published in respect to the plaice and other flat-fishes year by year?

Prof. McIntosh scoffs at the basal researches on the physico-chemical conditions of sea-water in respect to the life in the sea as likely to be of any importance. He selects in particular "vitamines." His remarks should be read in connection with my paragraph to which he refers. It is self-evident that even the largest quantity of food can be of no use to a living animal unless that animal has the requisite power to build up that food into its own living matter. The understanding of this at every age of the animals in question—and of animal life in general—is the object of these researches. There seems to be no such thing as "pure sea-water" without "vitamines."

It may not be generally known that an almost judicial committee appointed by the Development Commission is at present sitting on the question of fishery research. There is no member of that committee employed in fishery research, and, equally, there is no member of the committee who is incapable, by training or otherwise, of understanding any parts of the problems to be investigated. The report of that committee should shortly be issued. It will doubtless be an authoritative pronouncement upon the whole question as to the utility or non-utility of fishery investigations as proposed by the International Council and as undertaken by the Fishery Departments of England, Scotland, and Ireland.

X. Y. Z.

The Plumage Bill and Bird Protection.

NATURE is doing a service to science, as well as to art, in having opened its pages to the discussion of the Plumage (Prohibition) Bill. For in the end the Bill should be drafted in harmony with the scientific facts concerning the bird-life it is designed to protect, and also with due regard for the æsthetic and decorative needs of mankind. There is one aspect of the subject which has hitherto been only lightly touched upon, but which, if unfettered, is sure to become of great importance in the future, namely, the domestication of plumage birds. Impressed with the success of its ostrich industry, South Africa has for some time turned its attention to the possibility of the domestication of other plumage birds. Experiments have already demonstrated that the marabou stork can be controlled in captivity and, in all probability, induced to breed. Attention has also been directed to the gregarious weaver-birds and other brightly coloured species; but the advent of war turned men's thoughts away from the arts of peace.

In all the considerations no biological difficulty presented itself which a thorough study of the nature and habits of the bird could not be expected to overcome; the chief problems were economic, namely, how profitably to produce the plumage in sufficient quantity to comply with trade requirements, so admirably met in the case of the ostrich. On the authority of Prof. Lefroy we learn that there are many egret farms in India, and the plumes are procured without cruelty; domestication of the same bird has also been considered in parts of Africa. With the encouragement which ornithologists could give, there is every likelihood that in the future great developments will take place in the production of domesticated plumage, procured in harmony with the highest humane sentiments and to the exclusion of plumage from the wild bird—a realisation which would be peculiarly acceptable to the trade as well as to zoologists.

Now if the Plumage Bill were passed in its present form it would close the door on all efforts of this kind, at any rate so far as importation into England is concerned. Sir Harry Johnston indicates that, as a compensation, plumage might be procured from a dozen or more kinds of our domestic birds; but surely, in these days of Empire considerations, he would not wish us to isolate ourselves in prejudice from the Dominions overseas, as well as from the products of other countries?—a result which would follow from the carrying out of his suggestion.

Nor is this necessary. A study of the situation reveals that all the reasonable requirements of the supporters of the Bill can be met, and at the same time the avenue be left open for the development within the Empire of a trade in domesticated plumage. Instead of asking for a prohibition of import of every kind of plumage (except ostrich and eider-down), let the prohibitionists and others interested in the preservation of bird-life agree upon a list of birds the protection of which is desirable from any point of view, and then have the list appended to the Bill as a schedule of prohibitions. The carrying out of the intent of the Bill on these lines would be a simple matter, and additions to, and removals from, the schedule could be made as circumstances demanded. Passed in this form, the Bill would become a real stimulus to the activities of the Royal Society for the Protection of Birds and an effective measure for the inculcation of humane principles and regard for bird-life generally.

As Prof. Lefroy has shown, the trade has no concern in avian rarities, but is prepared to work with bird-lovers in the direction of their preservation and in the discouragement of every kind of cruelty. Before the war a list of prohibited plumage had been agreed upon by the trade representatives in the leading European capitals. When the matter of bird-protection is discussed in a calm manner, with full knowledge of the facts involved, it is seen that the interests of the bird-lover and of the plumage trade are alike, and the simple modification of the Bill suggested above would meet the needs of all.

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The Standard of Atomic Weights.

IT is with considerable surprise, as a chemist, that I see in NATURE of April 22, p. 230, arguments as to the structure of atoms based on the deviations of the atomic weights of elements from whole numbers *on the standard* O = 16·00 The reasons for the use of this arbitrary and inconvenient standard are now matters of ancient history, and the values of Stas, which were regarded as fundamental at the time when the standard was adopted, have now been shown by many independent lines of experiment to be inexact. It is almost pathetic to observe modern experimenters who have determined equivalents by the accurate analysis of hydrogen compounds, such as hydrogen chloride, methane, hydrogen bromide, ammonia, etc., all of which are more easily obtained in a state of purity, and analysed, than oxygen compounds, compelled to multiply their results by 1·008 in order to bring them into line with the standard of O = 16·00.

A glance at the International Table of Atomic Weights will show that very few of the elements form oxygen compounds suitable for analysis, and the statement to the contrary, found in most elementary text-books, is clearly inaccurate. A great number of equivalents, on the contrary, have been referred to Ag = 107·88. This number can be brought into ratio with oxygen only through the intermediate link of nitrogen, the atomic weight of which has been most accurately determined by the analysis of ammonia. The latter involves the ratio 1·008 to get the ratio to O = 16·00. But the atomic weight of chlorine has been most accurately determined directly to H = 1·00, and the ratio Ag : Cl is also very accurately known. From hydrogen to chlorine, from chlorine to silver, and from silver to a large number of other elements seems to be the most natural proceeding. Oxygen then comes in from the ratio H : O found by Morley, Scott, and Burt and Edgar. This is now probably one of the most accurately known atomic weights. The above is one instance only of the extraordinary branch-chain methods now necessary in order to get the experimental numbers referred to oxygen.

On the theoretical side the advantages of the hydrogen standard are self-evident. No one has ever pretended that the adoption of oxygen as the unit has any theoretical significance; the retention of the number O = 16·00 alone is sufficient to prove this. The accumulating evidence on the physical side, such as atomic numbers, the structure of atomic nuclei, the periodic law, and the like, all points unmistakably to the mass of the hydrogen atom as the natural standard. It is no longer correct to say, as is still done in elementary books, and even in other quarters, that the standard of atomic weights is a matter of indifference, and that, apart from experimental reasons, one element is as good as another. We have almost certain evidence that the hydrogen nucleus is a fundamental constituent of all atoms. Prout's hypothesis being thus reinstated, there can be no doubt as to the suitable standard of atomic weights, and Dalton's choice has had a most remarkable vindication.

When, therefore, arguments are advanced based on the standard O = 16·00, it seems time to suggest that some steps should be taken to put an end to the prevailing confusion. Physicists have never taken kindly to the oxygen standard, and there is no longer any reason why chemists should be given needless trouble. I have, in my elementary lectures, made a practice of using the hydrogen standard, and thus avoiding all the confusion in connection with vapour densities, etc., which comes in with the other system.

There is one other point which seems to me of importance. On the oxygen scale the atomic weights of a number of elements differ by about half a unit from whole numbers. It has been conjectured that these elements are mixtures of isotopes, with atomic weights which are whole numbers. But if there is anything in the theory of isotopes to justify this, it can only rest on the hydrogen nucleus, and the atomic weight of hydrogen should be taken as unity. If this is done, it is found that the suspected elements are replaced by those not at present under any clouds of suspicion. The following table will illustrate this point:

Element	Atomic Weight O = 16·00	Atomic Weight H = 1·00
Chlorine	35·45	35·18
Magnesium ...	24·32	24·14
Silicon	28·3	28·1
Zinc	65·37	64·88
Copper	63·57	63·10

It may be that there is some real physical reason for taking O = 16·00, and then supposing that, if some elements deviate from the whole number on this basis, they must be mixtures of isotopes, but this reason has so far escaped my attention.

There seems to me to be a good case for the Committee on Atomic Weights to consider whether the unit O = 16·00, adopted largely on account of the persistence of Ostwald, is any longer necessary. At best it was a temporary decision, and all the reasons which were advanced in its favour have now lost their force. I am convinced that the arguments in favour of a return to Dalton's unit are so cogent that, once they are clearly realised, they will be admitted.

J. R. PARTINGTON.
East London College (University of London),
April 23.

Mortlakes as a Cause of River-windings.

MORTLAKE on the Thames has a place-name which not only accords with the natural history of the place, but also supplies a word which might conveniently be brought into common use to signify a process which plays an important part in the development of every river system, just as the River Meander supplies a word to signify the windings of any river. The area between Barnes and the Thames was formerly an island *in* the river (Fig. 1), formed by a

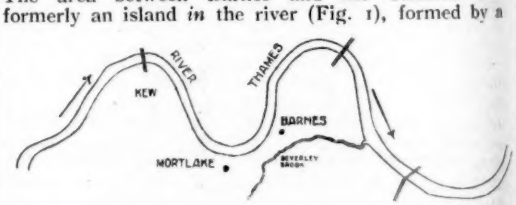

FIG. 1.

division of the stream into a northern and a southern arm reunited at the down-stream ends. The southern arm is now incomplete; the part of it remaining is included in the line of the Beverley Brook, which, having come from the south, turns to the east round a bold curve and joins the Thames. This leaves a gap between the convexity of the curve and the river at the point where it previously divided. This gap now forms the isthmus of a peninsula into which the island has been converted by the partial effacement of the southern arm of the divided river. Here Mortlake stands. It is on or near to the former line of the stream which has been in part effaced. This part has become a dead stream—a mortlake, the word "lake" having been used in the Middle English sense

as signifying a stream. Leland the Chronicler wrote that "there runneth a praty lake out of Sudeley Parke down by the Castle and runneth into Essebourne Brook at the south syde of Winchcombe." And again: "I passed over 2. or 3. small lakes betwixt Chiltinham and Gloucester and they resort to Severne." The word is still used in some places as meaning a stream; children on the Severn banks still sing of the moon as claiming to guide the ship "up the lake."

The first Lord Avebury, in writing of meanders ("Scenery of England"), mentions, as one of the results, "that the loop often remains as a dead river-channel or mortlake." Such loop-lakes are known in America as "oxbows." There is, however, a great difference. In the case of an "oxbow" the loop, formed by a lateral deviation of the river, has been entirely cut off from the main stream. A mortlake may be defined as the line of a closed part of one of the two sections of a river (previously divided so as to surround an island in the stream), the other channel remaining open and serving as a single channel for the river.

Of the two sections of a river enclosing an island, one of them at least must have a curved line. Two straight lines cannot enclose a space. If, then, the whole or a part of the stream in one of the sections be effaced, the remaining section, now forming the whole of the river, must have a more or less curved line. It must be a river-winding. The form and the length of it will, of course, depend on the shape and on the size of the former island. Thus a result of the formation of a mortlake may be one of those meanders or river-windings which are a familiar and picturesque feature in the landscape. The explanation of them has been a puzzle from classic times until the present. The subject was discussed at length by six contributors to NATURE in November and December, 1907.

I have come to the conclusion that the conversion of river-islands into areas bounded by single streams, more or less curved, is part of the ordinary course of river development. This, in my view, may be briefly stated thus: A newly exposed part of the earth's surface receives the rainfall on every square inch of it, but the water will not flow away in the form of a sheet; minute runnels form, and these will not be in straight lines parallel to each other. I cannot imagine straight "primary consequent streams" as they are sometimes depicted. Even slight obstructions would turn them aside so that they would meet and coalesce, thus forming a miniature network of streams, each of the meshes enclosing an islet. Then the water on the up-stream side of every islet will have alternative routes before it. These routes may, for a time, be equally easy, but they will not continue to be so; one of them will be preferred, and this may not be the most direct. The stream which continues may be the one which meets with the least obstruction, or it may be the one most necessary for continuance as having to receive longer or more numerous tributaries. A channel no longer needed will cease to be used; it will silt up. Then the islet will become continuous with an adjoining islet. This process being many times repeated, islands of increasing size—which may be large and, possibly, of very great extent—will result. Ultimately, they will all cease to be islands, in the absence of need for two channels. The development, in my view, is not *from* "primary streams" *into* a "complicated network" of channels, but from the complexity of a network of channels towards the simplicity of one principal stream with tributaries converging towards it. Certain it is that in a river system as we see it there is no network.

I do not wish to suggest that the formation of mortlakes is the only cause of river windings. Thirty-seven years ago I pointed out (in a paper read before a local society, and printed at the time) the influence of tributaries as one cause; and I recognise others. But the same laws govern the development of all rivers. Although Herodotus found the rivers of Egypt to be different from other rivers, I, in imagination, see the life-history of the Nile as very strikingly depicted in its present course. I have elsewhere shown ("The Lower Severn," Proceedings of the Cotteswold Naturalists' Field Club, xvi., 1909) an outline picture of a thousand miles of the Nile below Khartum compared with one of ten miles of the Severn below Gloucester. The resemblance is so close as to lead to the remark that it almost seemed as if the one figure had been drawn in ink on the second page of a sheet of paper and the other by pressing the ink before it was dry against the opposite page. The size of the two rivers and the character of the rock formations being so very different, it is at least remarkable that the course of the two should be so very much alike. In the *Times* of a recent date (March 15) is a report from Dr. Chalmers Mitchell of his view from an aeroplane in passing above the railway between Wady Halfa and Abu Hamed. He saw "huge cliff-lines submerged at intervals by desert," which suggested the "proper bed" of the Nile. It is really a relic of the time when the area, now partly enclosed by the great sickle-shaped curve of the Nile, was a huge river-island two hundred miles wide and five hundred miles long. That which Dr. Chalmers Mitchell saw was the line of the eastern arm of the Nile; it is now the line of a long mortlake.

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Eiffel Tower Wireless Time-Signals.

IT may interest a number of readers of NATURE to know that the Eiffel Tower is at present sending out two additional sets of "scientific" time-signals. The scientific signals are arranged as a time-vernier, gaining about one beat in fifty. They have hitherto been sent at 11.30 p.m. G.M.T., followed at 11.45, after the ordinary time-signal is concluded, by numbers which give the moment of the first and the last signal of the set, according to the standard clock of the Observatory of Paris. A comparison can thus be made with the introduction of a very small error, often not exceeding one-fiftieth of a second. These valuable signals have suffered from two awkward features: In summer time they are inconveniently late, and the purring or snoring note (*ronflée*) on which they are sent is much obscured by atmospherics when the latter are bad, so that sometimes one failed to pick up the identification breaks which occur at the end of every sixty beats.

In addition to the old series, which remain unchanged, two new series are now being sent; these are on wave-length 2600 metres and a high musical note that cannot be confused with atmospherics. Otherwise they are the same as the original —300 dots, the 60th, 120th, 180th, and 240th being suppressed. They are sent: (1) at 10.30 a.m. G.M.T., the comparison numbers giving Paris time following after completion of the 10.45 ordinary signal; and (2) at 11 p.m. G.M.T., the comparison numbers being sent after the 11.45 ordinary signal, along with those which refer to the old 11.30 signal, the two references being distinguished by the letters ML (*musicale*) and RF (*ronflée*) respectively. The new series are beautifully clear, and ought to be of great service to those who require accurate time.

R. A. SAMPSON.

Royal Observatory, Edinburgh, April 17.

Some Tests of the 100-in. Hooker Telescope.

By DR. GEORGE E. HALE, For.Mem.R.S., Director of the Mount Wilson Observatory.

THE construction of a telescope of very large aperture is necessarily an experiment the final success of which can be determined only by the results of astronomical observations. After the mechanical and optical difficulties have been overcome, there remain those disturbances of the atmosphere which are of little importance with small apertures and low magnifying powers, but become more and more serious as the diameter of the objective and the scale of the image are multiplied. Thus in undertaking the construction of a reflecting telescope of 100-in. aperture, while we had the advantage of experience with the 60-in. Mount Wilson reflector, we frankly recognised that the outcome must remain in question until the completion of tests made under customary atmospheric conditions.

As contrasted with the 60-in. reflector, the full measure of advantage attainable under *perfect* atmospheric conditions would be as follows:

	Light collecting power	Scale of focal image	Resolving power
60-in. reflector	1	1	1
100-in. „	2·8	1·7	1·7

This means that either in direct photography or in spectrographic work with a given dispersion the larger instrument should bring within range stars about one magnitude beyond the reach of the 60-in. The advantage thus gained would be important, as two illustrations, out of many that might be given, will suffice to show. Only two or three of the brightest stars can be studied with the most powerful spectrograph of the 60-in. telescope, which is not much inferior in dispersion to the instrument used by Rowland in his work on the solar spectrum. The same high dispersion, if employed with the 100-in. reflector, could be applied to several times as many stars, representing most of the principal stages of stellar evolution. At the other end of the magnitude scale, the 100-in. telescope should be able to record photographically many millions of stars too faint to be reached by the 60-in.

In the second place, the increased scale of the focal image, whether in the principal focus of the large mirror or at the Cassegrain focus, where the 100-in. telescope has an equivalent focal length of 134 ft., should separate more widely the crowded stars at the centre of globular star clusters, thus permitting them to be studied without confusion with one another; it should increase the precision of measurement in such difficult work, for example, as that involved in detecting the very small changes in the configuration of spiral nebulæ caused by their internal motions; and, to give no other illustrations, it should permit minute details, not previously photographed, to be recorded on negatives of such objects as the moon.

Finally, the increased theoretical resolving power, if realisable in practice, should permit the visual measurement of the components of very close binary stars, which cannot be separated by the smaller instrument, not merely because of the overlapping of their images during periods of poor seeing, but also because of their inherent irresolvability due to the wave-length of light itself.

In spite of the fact that most of the tests have been applied under the comparatively poor atmospheric conditions of the winter season, the early results are very satisfactory. It has become possible to include in our regular spectrographic programme stars one magnitude below those studied with the 60-in., so that the radial velocities and spectroscopic parallaxes of stars down to the tenth magnitude are being measured in large numbers by Dr. Adams and his associates. This involves a notable extension of the range of our investigations on the structure and motions of the stellar universe. Similarly, an important advance in our researches on stellar evolution has also been rendered possible, bringing to light new and curious types of stellar spectra and interesting phenomena in the spectra of variable stars at minimum brightness. The spectra of the long-period red variables of the Md class, most of which were too faint for satisfactory observation with the 60-in., are now being systematically photographed by Dr. Merrill with the Hooker telescope. One of these stars has been found to show the chief nebular lines in its spectrum, a matter of peculiar interest because of the fact that these lines have previously been observed only in nebulæ and in temporary stars. With low dispersion, the spectra of stars of the fourteenth magnitude have been photographed by Dr. Shapley with moderate exposures at the centre of globular clusters.

The preliminary results of the photography of nebulæ have also been very satisfactory, both at the principal (Newtonian) focus of the 100-in. mirror and at the 134-ft. Cassegrain focus. The photographs indicate an important advance over the 60-in. telescope, and leave no doubt that the desired increase in the precision of measurement, rendered possible by the larger scale of the images, will aid materially in the study of the internal and proper motions of spiral nebulæ. A striking feature of these negatives, as compared with those taken with the 60-in., is the increased contrast of the minute nuclei in spiral nebulæ, which are brought into greater prominence by the larger aperture. This will render available for measurement a large number of sharply defined symmetrical points.

The character of the images may be judged from the accompanying reproduction of a photograph of the moon (Fig. 1), taken by Mr. Francis G. Pease at the 134-ft. Cassegrain focus on September 15, 1919. This negative, like others obtained by Mr. Pease with the Hooker telescope, shows smaller details of structure than we have previously been able to photograph.

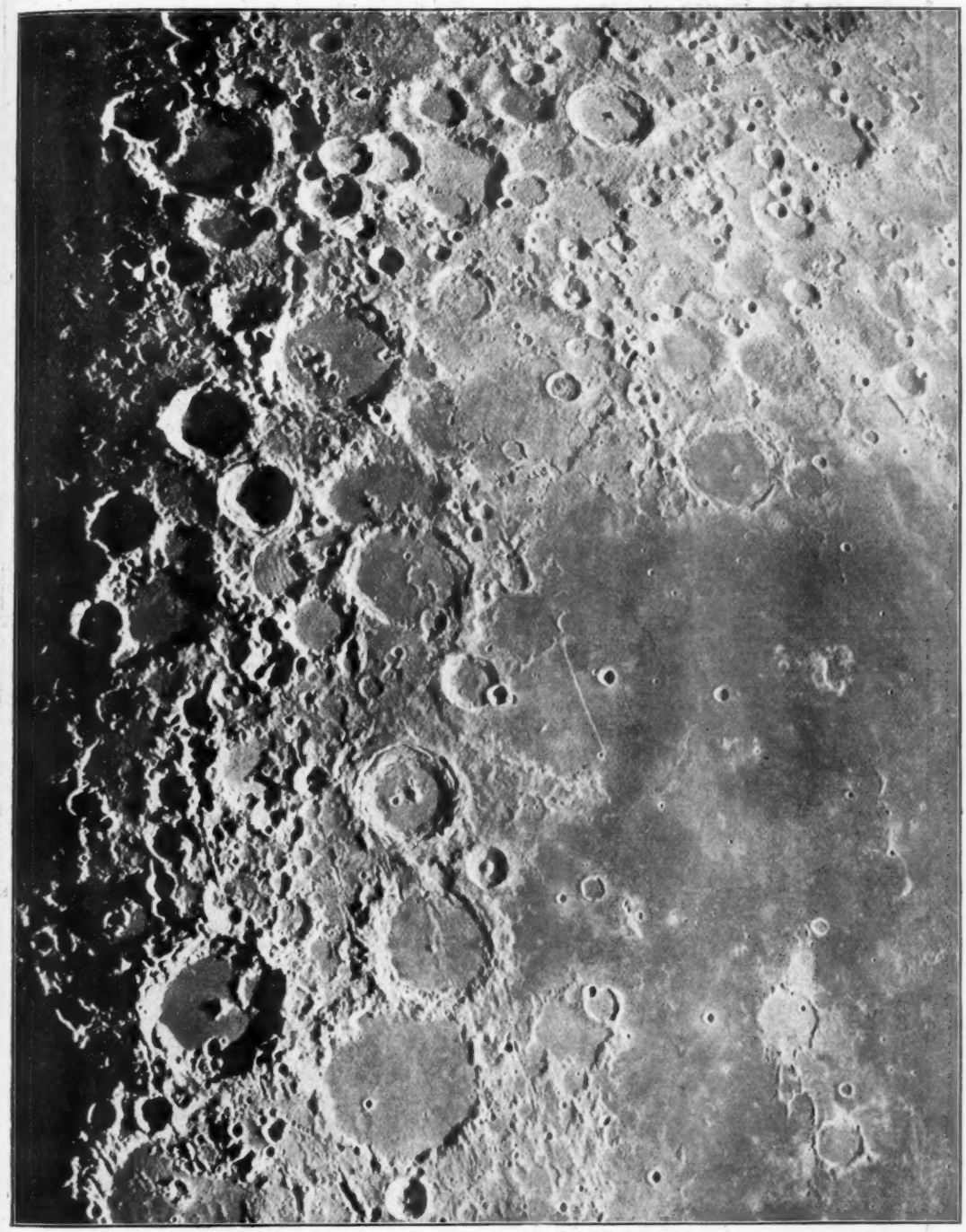

FIG. 1.—North central portion of the moon at last quarter. Photographed with the Hooker telescope of the Mount Wilson Observatory on September 15, 1919, by Mr. F. G. Pease. Scale: 1 in. = about 90 miles.

Perhaps the most interesting application of the 100-in. telescope hitherto made is that rendered possible by the utilisation of Michelson's interference method for the measurement of the spectroscopic binary star Capella. The method consists in completely covering the 100-in. mirror by a screen in which are two slits, which can be placed at any desired distance apart. Light coming from a point source, such as a single star at a very great distance from the earth, passes through the two slits and is brought to focus by the large mirror. A system of interference fringes may then be seen under a telescopic power of about 5000 diameters, which are sharply defined even on a night of poor seeing. If the star is single, the fringes remain visible even when the slits are separated by the full diameter of the 100-in. mirror. But if the star is a very close double, the fringes will disappear (assuming the members of the pair to be nearly equal in brightness) when the slits, set by observation at the proper position angle, are moved apart to a distance that depends upon the angular distance between the star's components.[1]

The following measures of Capella, made by Dr. Anderson, indicate the possibilities of the method:

	Position angle	Distance
	°	″
1919, December 30 ...	148·0	0·0418
1920, February 13 ...	5·0	0·0458
" " 14 ...	1·0	0·0451
" " 15 ...	356·4	0·0443
" March 15 ...	242·0	0·0505

1 In practice, a somewhat different technique, giving the same result with higher precision, is employed by Dr. Anderson.

When plotted, these points fall accurately on an ellipse. The method, which has been tested experimentally in the laboratory, not only allows binaries that cannot be resolved by other means to be measured with very high precision, but also permits *twice* the theoretical resolving power of the Hooker telescope to be attained in practice, even when the seeing is poor.

This application of the interferometer was suggested by Prof. Michelson many years ago and used by him in the measurement of the diameter of Jupiter's satellites at the Lick Observatory in 1891. The possibility of seeing the fringes under ordinary atmospheric conditions with the full aperture of the Hooker telescope was demonstrated by Prof. Michelson during a visit to Mount Wilson last September. The method will have many applications, and should be utilised by observers with instruments of moderate aperture who wish to resolve close doubles and to increase greatly the precision of their measures.[2]

From this record of the preliminary tests of the Hooker telescope it will be seen that in light-collecting power, in the increased scale and improved photographic definition, and in the added possibilities of optical resolution attained through the application of Michelson's method, the new instrument has not disappointed our hopes. We must now endeavour to utilise these advantages in the extension and development of our researches on stellar evolution and the structure of the universe.

2 For an account of this method, see Michelson, "On the Application of Interference Methods to Astronomical Measurements," *Phil. Mag.*, July 1890.

Artillery Science.

By SIR GEORGE GREENHILL, F.R.S.

"THE religious attachment of the officer of artillery to the practice of his predecessors" was described by Benjamin Robins about 1740, and his attachment persisted with unimpaired devotion right up to the war. There he found himself outclassed at the outset, out-gunned and out-gunnered; the little artillery he took out was small and puny, and not of the right sort required—"pas de celle qu'il faut." Our Artillery Authority cannot be said to have understood what it spelt, the word "artillery."

On the assumption of our politicians that this country was never going to war again, an interdict had been laid on England of seven lean years; and when they were up, the lean years got an extension leading right up into the war.

A well-disciplined Army Council had been formed, obsequious to the Minister, with instructions to resist all suggestions of military progress—housed in a magnificent new palace in Whitehall, the barracks of an army of War Office clerks, provided out of a reduction of the Regular soldiers.

Temple of Victory it cannot be called. The stone slab over the portal is still blank, ready to receive the appropriate motto, with no derangement in the epitaph:

PACEM PARA BELLUM SI VIS.

The mentality of the Army Council can be glimpsed in its attitude to Flight in warfare. The Wright brothers framed on their wall the egregious answer of the Secretary in the official jargon: "I have nothing to add to my last letter to you. The War Office is not disposed to enter into relations with any manufacturers of aeroplanes."

This was in March, 1913, and only the next year we were running the risk of our whole Army being completely surrounded, with no airmen to scout for us. The evil name "Maubeuge" would have been written on our history as indelibly as "Jena" and "Sedan" were on others. No wonder the German squadrons could fly all over England and London with impunity, in the face of all our air defence.

The belated arrival in the war of the Tank is another similar story. Military prejudice preferred to muddle along in a stalemate of trench

warfare, at a cost of two years' delay, of intolerable waste and slaughter, before it could be persuaded to take up this new revolutionary idea. The German advance walked over our trench warfare system in the spring of 1918, and took all our guns.

Technically bold as a lion, our military soul was intellectually a very timid bird, and shuddered at any suggestion of novelty and progress. Whenever I asked an artillery officer: "What did you learn as a cadet at the Royal Military Academy?" the answer came in the invariable formula: "I learnt nothing when I was at the Shop."

The Shop! Not a workshop, except so far as the "ca' canny" slogan would carry. And yet we find this nickname, full of meaning and contemptuous, is countenanced by authority, from the Governor downward, as a surrender of all Prestige. It should be made a crime of a military nature ever to use such a derisory, contemptuous *alias*, too descriptive of the obsolete, decadent traditions of the place.

The Army List gives a whole page to the catalogue of the staff of the Royal Military Academy, Woolwich, full of official Army titles. Low down on the page a line is to be seen, and under it a list of half a dozen names, the civilian instructors who should carry out the real work of the place.

Nothing was ever so Prussian, not even in Prussia. But the line has a more sinister meaning still; it emphasises one of the important reforms of the Cardwell scheme, and excludes all those appearing under it from retiring allowance, while every Civil Service clerk is *pukka*, subsidised and covenanted, on the strength of a Civil Service examination, medical or otherwise. A sailor would compare the Academy to a boat trimming too much by the stern, with too many cocked hats in the stern sheets.

This the only source of supply of our artillery officer does not run clear; it commissions him with the brand of second class, with all the mental outlook implied of indolence and apathy.

Thinking officers among them deplore the arrangement, and are beginning to confess to their deficiency of all artillery science in the war; but, with military docility, they are afraid to say much, and formerly, before the war, would bring upon themselves the scowl of the senior officer, and the disparaging epithet of "scientific."

The old school aimed at being as close an imitation of cavalry as possible, and a stable boy was the noblest gunner of them all, prepared to carry out a gallop of a few seconds over Woolwich Common, with a little gun on wheels behind. The idea was deprecated of firing off his gun, in imitation of the practice exacted in real warfare, as likely to wear the gun out, and so provided a good excuse.

But here is a Disadvantage of Durability, especially in artillery, and most of all in its traditions. Our guns were always obsolete when they were most wanted.

So this gunner preferred to seek the seclusion of his stable before the guns began to shoot; he was encouraged to be gun-shy, and to despise any sort of artillery that could not go at a gallop behind horses. His favourite arm was this *corps d'élite*, the plaything of the I.R.C. (Idle Rich Class), very expensive to maintain in peace, and of little proved utility in war commensurate with the cost.

But motor artillery has come to stay as the real artillery, unless "bilked" by the old school. This was the sort required in the war, and in peace it is not eating its head off, like horses in a stable, and is never tired on the march. De Wet was run to earth very soon by a squadron of motor-cars never giving his horses any rest: what our old cavalry tactics never could effect.

The civilian has grasped the paramount importance in modern warfare of heavy long-range artillery; and he must be careful that the lesson has not been lost on the regular gunner, or allow him to return to his ancient, worn-out traditions. Such long-range fire was declared officially of no military value, until our poor fellows came under the accurate fire of the long-range German howitzer, with no protection from our own side.

German science could always astonish our sleepy regular gunner, in providing a gun that could bombard Paris, and London too, when it could be brought up as near as Calais. How much longer would the war have lasted then? although the fire was declared of no military importance by those who did not suffer under it.

This advanced German artillery science, as well as of the chemical and aeronautical science, was the outcome and product of the Military Technical Academy in Berlin, a magnificent institution such as our Ministers thought England was too poor to afford. Sixty officers were under instruction there in a three years' course more thorough than exacted to-day for honours in the university. No wonder our feeble amateur military science went down before such superior training.

I was once privileged to visit the Berlin Academy, under the guidance of Prof. Cranz, and to inspect the instruction in all branches—ballistics, aeronautics, and electricity. There, for one thing, I remember seeing the electrical class occupied in making the antennæ of wireless telegraphy. This was ten years ago, when aeronautical science and flight were derided by our War Office authority, and opposed on the score of economy. We shall not feel safe in England until we set up a rival institution, but it must be as far apart as possible from the Woolwich tradition. South Kensington would be an ideal site, say in the building of the old School of Mines and Naval Architecture and alongside the Imperial College of Science, as the Berlin Academy is a neighbour of the Charlottenburg Technical High School, with the same

advantage of the free use of laboratories and special professorial lectures. Our artillery will then be able to throw off the badge of second class and claim to take the rank of first class again.

A cadet military college can only carry on the initial stage of the education of the artillery officer, and for that it is better for him not to be isolated too early from the other military branches. Many a scheme for the amalgamation of the military colleges will be found pigeon-holed in the War Office, awaiting the pressure required to be exerted on the opportunist. The artillery could then make its selection from the whole list of Army candidates, and with proper prestige secure the pick of the bunch. It would not then have to submit, as at present, to put up with the leavings of the Royal Engineers, and to be branded as second class.

The pick of the officers, after some military service, would be selected for a further course at our equivalent of the Berlin Military Technical Academy, where neither indolence nor apathy was tolerated, but stigmatised as bad form, so I was informed. Here they would find a standard of university rank, in a centre of keen intellectual activity.

But the atmosphere of all Woolwich is close and ill-ventilated. Throw open the window, and let in air and light! The Royal Military Academy there is unhealthy, physically as well as mentally, seated on the safety-valve of the main drainage of all South London. The buildings are antiquated and worn-out, fit only to be mined and blown up at the moon, and then a more healthy atmosphere, physical and intellectual, might be formed. With the solidarity of any other trade union, Woolwich strongly opposed dilution. But Dilution proved the best material, and carried the war to a successful conclusion, and so the insidious efforts at his elimination in peace must be watched carefully, and countered by a plentiful entry of university candidates from the outside.

The country will never cease to shiver at the recollection of our narrow escape from defeat and utter ruin, and will listen to no specious political views of opportunist economy likely to place us again in a state of military inferiority.

Obituary.

Dr. Rudolph Messel, F.R.S.

DR. R. MESSEL died on Sunday, April 18, in his seventy-third year. Death came to him as a happy release but to a large circle of friends familiar with his social qualities and many acts of unostentatious generosity the loss is severe and will be deeply mourned. He had long been one of the most notable of our chemical manufacturers as pioneer founder of a most important industry, for he was the first to produce sulphuric anhydride from its elements on a large scale.

Messel was born in Darmstadt and came to this country, at the conclusion of his university career, shortly before the Franco-Prussian War; when this broke out he returned to Germany and volunteered for service but owing to a physical disability, I believe, he was drafted into the Army Service Corps and was wounded while on ambulance duty. He lost no time in returning to England and became assistant to the late Dr. Squire, a man of considerable ability and originality. Messel had qualified at Tübingen as a chemist under Strecker, who naturally took an interest in the then infant alizarin industry, as he had worked with alizarin. Strecker foresaw the important part that fuming sulphuric acid was to play in the industry and directed Messel's attention to the fact, suggesting that he might well seek to supply the want. Messel, therefore, was fully conversant with what had been done and when Squire, possessed of the same idea as Strecker, suggested to his assistant that he should set to work on the subject, he was soon ready with a process, having at once resorted to the use of platinum as a catalyst in order to bring about the interaction of sulphur dioxide with atmospheric oxygen.

A patent was taken out by Squire in 1875 and he and Messel described their process in a paper read to the Chemical Society early in 1876; but this was not published. Their works were erected at Silvertown, on the Thames; the manufacturing process was rapidly developed through Messel's skill and intense devotion to his task. Not alone were English wants soon met but a considerable quantity of the acid was supplied to the German colour-makers. The Badische Anilin- & Soda-Fabrik was led largely to develop the manufacture of the acid in connection with the production of synthetic indigotin; but the "splash" this firm made in 1900, when it published the results of its experiments in considerable detail, was unwarranted. Practically everything essential then put forward had long been a matter of everyday practice with Messel. Had not commercial considerations prevailed, he might well have upset the patents; but he was ever a man of peace, as well as a modest man, so he made no attempt to claim the credit that was his due. He acquired the German patents at a peppercorn price but his former countrymen never had the honesty to do him public justice.

The writer was a frequent visitor at Silvertown in early days and was always impressed by the remarkably systematic manner in which the works were operated. Messel was ever on the look-out for improvements and ever ready to make them. His chief trial in later years was the difficulty he experienced in persuading his conservative British

partners to consent to the scrapping of inefficient plant and the substitution of improved appliances. A man of great energy, he was ready at all times to work twenty-five hours a day for several days together. He long lived on the works in the most modest quarters and his all-seeing eyes were everywhere. In Germany the success of the great chemical works has been mainly due to the effective co-operation of a variety of workers, representing the different sides of the business, supported by a small army of highly disciplined, qualified scientific assistants; but Messel did everything himself: his versatility was astounding; he was not only chemist but also engineer, works manager and business man; he had no scientific staff but only an assistant or two.

Though a German but a German fired with Jewish imagination, Messel appreciated and practised English methods. Aided only by the most modest resources, he long held his place successfully against his rivals in Germany. Probably much of his early success was due to his sympathetic attitude towards his workmen, by whom he was generally beloved; but Messel was not only a worker, he also played hard. In great social request, he knew everyone: Gilbert was one of his great friends. Of late years Messel had been one of the most familiar and popular figures at the Savage Club.

Messel's eminent scientific services to industry were recognised in 1912 by his election into the Royal Society. No other compliment could have given him greater satisfaction. Though a manufacturer, he lived for science and in the atmosphere of science and not the least of his merits is the example he has thus set. H. E. A.

PROF. A. K. HUNTINGTON.

BY the regretted death, on April 17, at sixty-four years of age, of Prof. Alfred Kirby Huntington so shortly after relinquishing the chair of metallurgy at King's College, University of London, which he had occupied since 1879, British technical science loses one of its old guard, and both metallurgy and aviation are the poorer by the loss of an indefatigable worker and an outstanding personality.

Though it be admitted that Prof. Huntington's name is linked with no spectacular discovery, his work, beyond its professional duties, was continuous, scholarly, and of marked originality. In both respects he therefore exercised a determinative moulding influence upon the two generations of men he trained in this rapidly widening field of science. His career, indeed, coincided with what we may justly regard as the Renaissance of non-ferrous metallurgy. For nearly forty years he was invariably abreast, more usually in the forefront, of the many new departures which have marked it. A physicist as well as a chemist, his researches on the micro-structure of metals and on "corrosion" have added essentially to our metallographic knowledge; his paper on "The Concentration of Metalliferous Sulphides by Flotation," read before the Faraday Society in 1905, broke ground which has been gratefully cultivated by others, and provided the starting-point for fresh researches; whilst in the discussion of such diverse technics as those of copper-smelting, cyanidation, nickel metallurgy, etc., many have owed essential enlightenment to his suggestions and criticisms, imparted with a kindly, if somewhat gruff, sententiousness.

Prof. Huntington rendered yeoman service in the earlier development of several of our now important technical associations; thus one recalls his two papers (upon "The Mexican Amalgamation Process" and "The Metallurgy of Nickel and Cobalt") which were read at the first annual meeting of the Society of Chemical Industry in 1882. Later he was actively interested in the formation of the Institution of Mining and Metallurgy, becoming its second president in 1894, and remaining an honoured member of council until his death. The mere enumeration of his contributions to its Transactions occupies a whole page of index. In 1913 he succeeded to the presidential chair of the Institute of Metals, and to that society he gave of his energy and experience with equal freedom. During the war his specialised knowledge of high explosives was placed at the disposal of, and fully utilised by, the Admiralty.

A marked characteristic of Prof. Huntington's metallurgical outlook was its practicality and its constant insistence upon the economic aspect of the problem under consideration. His motto might seem to have been: "First write your equation in economics, and the remaining 20 per cent. of technics will be easily and better supplied thereafter"—though it must be admitted that he could be unsparing if that balance appeared faulty!

Prof. Huntington's intense practical interest in aeronautics, which advancing years were powerless to quench (since, in addition to his exploits in ballooning, he was until quite recently his own pilot and flew his own 'plane), made him famous to a wide circle; but it is to his services to modern metallurgy that special tribute is due.

DR. A. J. CHALMERS.

THE death of Dr. A. J. Chalmers in Calcutta on April 5 causes a gap in the ranks of British workers in tropical medicine, and will also be deeply regretted by his many friends in this country, as well as in the various Colonies in which he held important posts. The son of a Wesleyan minister, Dr. Chalmers was born in London in 1870, but began his career at University College, Liverpool, which at that time formed part of Victoria University. His career in the Medical School during his student days was brilliant, and it was soon apparent that he had a bright future before him. He gained the Holt fellowship of his college in 1890 and 1891, and obtained honours on taking his degree as M.D. Soon after

taking his F.R.C.S. (England), he had a great desire to travel, the tropics especially having an attraction for him, and he joined the West African Medical Service in 1897. He served as a medical officer with the Ashanti Field Force in 1900, and was with the British troops that were besieged in Kumasi, who, after some time, gallantly broke through the native hordes and regained the coast. Dr. Chalmers attended to the sick and wounded with great energy and devotion and was mentioned in despatches by the commanding officer, and received the medal with a clasp. In 1901 he accepted a post under the Ceylon Government as registrar of the Ceylon Medical College. Here his capabilities as administrator and organiser were brought into full play. He soon developed this institution into an excellent medical school, the licence of which is now recognised by the General Medical Council.

While in Ceylon Dr. Chalmers first turned his attention to the tropical diseases that came under his notice, and never spared himself in working among the resident Europeans and natives who came to him. Resigning his position in Ceylon in 1902, so that he might devote more time to the study of tropical diseases and parasitology, he returned to England. It was then that he conceived the idea of writing a much-needed manual on tropical medicine; and in collaboration with his colleague, Dr. Castellani, in Ceylon, he began the work which will remain a monument to his memory. The preparation of "The Manual of Tropical Medicine," which has now reached its third edition, cost him a great amount of time and labour. He was an ardent worker in many fields, and carried on research not only in pathology and bacteriology, but also in parasitology, especially in connection with diseases of the tropics. His work on the Mycetoma will always be connected with his name.

From 1912 Dr. Chalmers devoted more than a year to the study of the cause of pellagra, and in company with Dr. Sambon visited Italy and Rumania. On his return he carried on researches in this country, with the result that cases of pellagra, a disease unknown to be endemic in Great Britain, were found in Hertfordshire and Scotland. Later he visited Egypt and travelled up the Nile with the same object, and accumulated much valuable data in connection with the study of pellagra and other diseases such as endemic hæmaturia.

On his return to England Dr. Chalmers gave some time to the study of the history of medicine, and became an enthusiastic lover of ancient literature—especially that dealing with the medical art. After some time he felt again the call of the East, and often expressed a wish to return there. In 1913 he accepted a post as director of the Wellcome Research Laboratories at Khartum, which he filled with conspicuous success. He became a member of the Central Sanitary Board, and also of the Sleeping Sickness Commission of the Sudan. Dr. Chalmers continued there until a short time ago, when he left the Sudan, accompanied by his wife, with the object of returning home *via* India, Japan, and America, and when in Calcutta was unfortunately seized with his fatal illness.

PROF. L. T. O'SHEA.

LUCIUS TRANT O'SHEA, professor of applied chemistry in the University of Sheffield, who died suddenly from cerebral hæmorrhage on April 18 at sixty-two years of age, was educated at the Grammar School and at Owens College, Manchester, and went to Sheffield in 1880 as assistant lecturer and demonstrator in chemistry at Firth College. In 1890 he became lecturer in mining chemistry, and in 1905 professor of applied chemistry, in the university. For the past twenty years he had specialised in the study of explosives as applied to mining operations, and of the coking of coal in retort ovens. He also did much work on the safety of coal mines, particularly with regard to the effect of the gases given off by the coal and of coal dust on explosions in mines. He was a fellow of the Chemical Society, a member of the Society of Chemical Industry, and hon. secretary of the Institute of Mining Engineers.

Prof. O'Shea published "A Contribution to the History of the Constitution of Bleaching Powder," and "The Retention of Lead by Filter Paper," about the time of the lead-poisoning epidemic in Sheffield more than thirty years ago, and some years later, with Dr. W. M. Hicks, he produced electro-iron of almost perfect purity, which the present writer had the privilege of using for experiments when helping to lay the foundations of theoretical steel metallurgy, for which pure iron was required as a basis for study. He also published "A Note on the Woolwich Testing Station," "A Testing Station for Mining Explosives," and "The Safety of High Explosives, with Special Reference to Methods of Testing."

In 1901 Prof. O'Shea went out to the South African War in command of a detachment of the 1st West Yorks Royal Engineer Volunteers, remained until the declaration of peace, and was given the Queen's medal with five clasps. In 1914 he was made O.C. of the O.T.C., Sheffield University, with the rank of captain in the unattached Territorial Force, and he was an energetic and inspiring leader.

Prof. O'Shea was not able to devote a large proportion of his time to research, but he will be greatly missed for the painstaking work he did in the training of students in chemistry as applied to mining and to the coking of coal, and in the general preparation of fuel for industry.

A. McW.

A MAN who had great influence in the applications of science to the use and convenience of man has passed away in MR. THEODORE N. VAIL, well known to many in England, as well as in

his homeland across the Atlantic. Mr. Vail's life-work was the development of the "Bell" telephone system in the United States, and it is to his personal initiative that the enormous growth of the American Telephone and Telegraph Co., of which he was for many years the president, is largely due. He was a rare combination of the business man, quick to see opportunities and far-seeing in his policy, and the patient, scientific worker. It is not too much to say that the success of the American telephone system, culminating in the achievement of speech from New York to San Francisco, is mainly due to the unremitting attention that he gave to the organisation and prosecution of research, and the technical laboratories that he initiated are the finest in any industrial undertaking. It is pleasant to think that, unlike many workers on parallel lines, Mr. Vail lived to behold the fruit of his labours.

THE death is announced, at the age of eighty years, of DR. JOHN A. BRASHEAR, the founder of the well-known American firm of makers of astronomical and physical instruments. In his youth, while working as a machinist, Dr. Brashear devoted himself to the study of astronomy, and made his first telescope while pursuing this hobby after his working hours. With this instrument he made many observations, as a result of which he contributed articles to the daily Press on comets, etc. These attracted the attention of Mr. William Shaw, whose offer to build and equip for him a good shop for the production of astronomical instruments was accepted. This ultimately developed into the works of the John A. Brashear Co. at Pittsburgh, which turns out instruments that are used in observatories all over the world. Dr. Brashear received the honorary doctorate from Pittsburgh and other universities, and from 1901 to 1904 was acting chancellor of the Western University of Pennsylvania, now the University of Pittsburgh. He was a member of many American and foreign scientific societies, and was a recognised authority on solar phenomena, lunar craters, and other subjects.

MR. JAMES METCALFE, who died on April 12, was born in 1847, and was locomotive superintendent of the Manchester and Milford Railway from 1867 to 1880. He was afterwards managing director of the Patent Exhaust Steam Injector Co., whose injectors are extensively used in locomotives. Mr. Metcalfe was elected a member of the Institution of Mechanical Engineers in 1906.

THE death is announced of MR. FRANK EDWARD PRIEST as having taken place on April 14. Mr. Priest was born in 1860, and was chiefly interested in railways, waterworks, and road and sewerage works. He took a great interest in aeronautics, and at the time of his death he was chairman of Messrs. A. V. Roe and Co., Ltd. He was elected a member of the Institution of Civil Engineers in 1896.

Notes.

FURTHER news from Capt. Roald Amundsen fails to explain his movements. According to the *Times* of April 23, a message has been received in Norway from the wireless station on the Anadir to the effect that the expedition will arrive at Nome, Alaska, at the end of July. Nome is the port Amundsen reached on his accomplishment of the North-West Passage in the *Gjoa* in 1905. Possibly his ambitions include the North-West Passage before starting on his North Polar journey. These two difficult journeys, in addition to the discovery of the South Pole and the not improbable attainment of the North Pole, would be a remarkable record for one man. A start on the polar drift from Bering Strait or Point Barrow entails a longer route than Amundsen had originally intended, so that he may be calling at Nome for extra stores. News of the arrival of Amundsen himself at Anadir needs confirmation.

NOW that political and social conditions are more favourable in the Near East, a certain recrudescence of archæological activity is evident. The recent discoveries of M. Hatzidakis at Mallia, in Crete, have been followed by a further discovery west of Candia. M. Xanthoudides has excavated a Cretan palace, which appears to date for the most part from the end of the Middle Minoan period to the end of the first Late Minoan period. The most important discovery made in the palace was a series of colossal bronze double-axes, measuring several feet in length in some cases. No such axes of this size have yet been found on Cretan sites, and their purpose is for the present obscure. Another excavation by M. Xanthoudides near Candia brought to light some pottery of Early Minoan date of a peculiar type. Similar pottery has been found only at one other site in Crete, and it does not appear to be typically Cretan. In shape the vases found resemble the so-called Minyan ware. In technique they have no parallel in Cretan wares. The detailed publication of both these excavations will be awaited with the greatest interest.

APPLICATIONS for grants in aid of scientific investigations bearing on agriculture are receivable by the Ministry of Agriculture and Fisheries not later than May 15. They must be made upon Form A. 230/1, copies of which are obtainable upon application to the General Secretary, Ministry of Agriculture and Fisheries, 72 Victoria Street, S.W.1.

THE Minister of Health has appointed a Committee to consider and advise on the legislative and administrative measures to be taken for the effective control of the quality and authenticity of such therapeutic substances offered for sale to the public as cannot be tested adequately by direct chemical means. The members of the Committee are:—Sir Mackenzie Chalmers (chairman), Dr. H. H. Dale, Dr. G. F. McCleary, Mr. A. B. Maclachlan, and Dr. C. J. Martin. The secretary is Dr. E. W. Adams, of the Ministry of Health.

THE following have been elected officers and council of the Society of Antiquaries of London:—*President:*

Sir C. Hercules Read. *Treasurer:* Mr. W. Minet. *Director:* Sir Edward W. Brabrook. *Secretary:* Mr. C. R. Peers. *Council:* Sir W. Martin Conway, Mr. V. B. Crowther-Beynon, Mr. H. R. H. Hall, Mr. W. J. Hemp, Mr. A. F. Hill, Mr. C. H. Jenkinson, Sir Matthew I. Joyce, Mr. C. L. Kingsford, Lt.-Col. G. B. Croft Lyons, Prof. J. L. Myres, Lord Northbourne, Prof. E. Prior, Mr. J. E. Pritchard, Mr. H. W. Sandars, Major G. T. Harley Thomas, Mr. R. Campbell Thompson, and Mr. W. H. Aymer Vallance.

THREE important scientific appointments will shortly be made by the British Cotton Industry Research Association, and the council of the association invites applications from qualified candidates. The posts to be filled are those of the heads of the departments of colloid chemistry and physics, organic chemistry, and botany. The minimum salary offered in each case is 1000*l.* per annum. Applications, accompanied by the names of two referees, must be received not later than Saturday, May 22. Forms of application and any further information may be obtained from the Director, British Cotton Industry Research Association, 108 Deansgate, Manchester.

INFLUENZA is abating somewhat in its severity, according to the latest weekly returns of the Registrar-General. The deaths from the disease for the week ending April 17 numbered only 306 for the ninety-six great towns of England and Wales, whilst for the three preceding weeks the deaths were 392, 379, and 332. A similar decrease is shown in the deaths for London, which for the week ending April 17 numbered 101, and for the three preceding weeks the deaths were 131, 124, and 105. The returns also show a decrease in the deaths from pneumonia and bronchitis. The age incidence of the present influenza epidemic resembles somewhat the character of the attacks in 1918 and 1919, which were entirely different, so far as age incidence goes, from previous attacks since 1890. There seems, however, now a tendency to revert somewhat to the former age incidence. In the present epidemic the deaths in London during the last twenty-six weeks numbered 1056, and of these 16 per cent. occurred between the ages of 0 and 20, 36 per cent. between 20 and 45, and 48 per cent. at ages above 45 years. In the virulent attacks of 1918 and 1919 the deaths were about 24 per cent. between the ages of 0 and 20, 46 per cent. from 20 to 45, and 30 per cent. above 45 years, the able-bodied being attacked most severely. The maximum number of deaths in any week in London during the present epidemic was 131, whilst in the summer epidemic of 1918 the deaths in one week numbered 287, and in the autumn of 1918 the deaths from influenza for two successive weeks, November 2 and 9, amounted to 2458 and 2433. For the ninety-six great towns the deaths for the same two weeks in November were respectively 7412 and 7557, against 392 in the week ending March 27 in the present epidemic.

IN *Man* for April Sir W. Ridgeway describes two wooden Maori daggers, part of a collection brought home by the late Col. Honner after the first Maori war in 1840–41. It was at first suggested that these implements were Potuki, or "flax-beaters," and it was doubted whether the Maori did use daggers. But Mr. Henry Balfour has described a bone dagger from the Chatham Islands, and some cultural similarities indicate a link between those islands and New Zealand, especially the Otago district. It is now certain that the Maori did use daggers made of wood and bone. As regards the Potuki, there is a class of beautifully carved examples which can never have been put to any practical use. Their exact function has not been recorded, but they were, perhaps, signs of dignity in the tribe. Sir W. Ridgeway remarks that the paper mulberry, from which tapa cloth was made, was brought to New Zealand by Maori immigrants. But it did not thrive, and the tapa-beater, so important in the social life of Polynesia, would thus fall out of practical use. "My suggestion is that it retained only a ceremonial significance, and that its parallel straight grooves conditioned the type of decoration which the Maoris subsequently applied to it."

IN the Journal of the Manchester Egyptian and Oriental Society for 1918–19, recently published, Mr. W. J. Perry discusses the significance of the search for amber in antiquity in connection with the megalithic problem. He supposes that the amber used for decorative purposes in the Mycenæan age may have been found in the Adriatic. It is not easy, however, to see why it should have been so readily adopted as a form of wealth, as it does not possess the attractiveness of gold and pearls. Mr. Perry suggests as an explanation of its value that amber, a solidified resin, may have been associated with the productions of certain trees venerated in Egypt as the source of resinous substances used in mummification and other death-rites. As a further explanation he refers to the Chinese use of jade and gold, supposed to convey vitality to those who consumed them. "In the case of the Chinese, whose civilisation can be accounted for on the hypothesis of a cultural movement across Asia from goldfield to goldfield, the desire for life, health, and immortality has played an important part in the production of philosophical systems, and thus it is possible that their civilisation itself owes its existence to that instinctive process." The theory is certainly ingenious, but the evidence in its support is still scanty, and the analogy of Chinese or Egyptian beliefs with the search for amber in Europe must be accepted with some caution.

THE trade routes of the British Empire in Africa is the subject of a paper by Mr. G. F. Scott Elliott in the Journal of the Royal Society of Arts for April 2 (vol. lxviii., No. 3515). Mr. Scott Elliott approaches the problem of future rail and steamer routes from a geographical point of view. He emphasises the location of the plateau regions in Central Africa, each of which above 5000 ft. is a possible centre for European settlement, civilisation, and trade. The problem as he sees it is to link these interior regions with British seaports by lines through British territory. He discusses at length the possible routes for railways linking Lakes Nyassa, Tanganyika, Victoria, Edward, and Albert. These lines, with the construction of a railway from Kashitu, on the Bulawayo-

Katanga line, would complete a Cape-to-Cairo route within British territory.

THE annual report on the Nile gauges and rainfall of the Nile Valley ceased publication during the war, the last number being that for 1912, published in 1914. The work has now been transferred from the Survey Department to the Ministry of Public Works, which publishes the records of the gauges for 1913 to 1918 as Physical Department Paper No. 1. In order to reduce the number of data, five-day means are given for twenty representative gauges between the delta barrage and Entebbe, on Lake Victoria. Tables are also given of monthly means for each of the six years, and the actual discharges on certain days at several stations on the main Nile and Blue Nile. These discharges were measured by the current meter, which Mr. H. E. Hurst, the author of the report, calculates has a probable error of not more than about 3 per cent.

TWO papers published recently by the Ministry of Agriculture and Fisheries (Series II., Sea Fisheries, vol. iv., Nos. 1 and 2) deal with the method of determining the age of fishes by inspection of the scales. It is well known that the material of the latter structures is laid down in more or less regular layers, and that there are differences between the substance deposited in the warmer, and that laid down in the colder, months. By counting these rings, then, an estimate of the age of the fish can be made. The method is not applicable to all scale-bearing fishes, and there has been much discussion as to its trustworthiness. In the first of the papers to which reference is here made Mr. R. E. Savage describes the structure of various scales as elucidated by special reagents and studied under polarised light. In the second paper Miss R. M. Lee has made a critical review of most of the important memoirs dealing with scale-markings, and subjected selected series of measurements to mathematical tests. Her general conclusions are that, with certain precautions, the method is trustworthy.

THE climate and weather of the Falkland Islands and South Georgia is the subject of a memoir compiled by Mr. C. E. P. Brooks, and published by the Meteorological Office as Geophysical Memoir No. 15. The Falkland Islands observations are all from Cape Pembroke lighthouse with the exception of a few discontinuous series from Port Stanley. The Cape Pembroke records date from the visit of the *Scotia* in 1903, when Dr. W. S. Bruce and Mr. R. C. Mossman started observations there in connection with their records in the Weddell Sea. The scanty South Georgia records are the result partly of various scientific expeditions, but are mainly due to the enterprise of the Argentine Fishery Co. in Cumberland Bay. Summaries of all available data, including those previously published, are given in the memoir.

THE Danish Meteorological Institute has published its issue for 1919 on the state of the ice in Arctic seas. As usual, the publication is in both Danish and English, and is well illustrated with charts. Information was scarce from the Beaufort and Bering Seas, Baffin Bay, and the western part of Davis Strait. In Spitsbergen seas the state of ice was about normal; the pack-ice off the west coast in April and May disappeared in June, and did not return throughout the summer. The ice in the fjords did not break up until May, which is later than usual and two months later than this year. The coasts of Iceland were singularly free from ice throughout the year except for a few days on the north-east in spring, and again in summer. Icebergs on the Newfoundland banks were normal in number and distribution. The Kara Sea, as usual, was navigable in the south and east in September, but there is no information for earlier summer months.

THE attention of systematic students of the Arachnida may advantageously be directed to J. Hewitt's "Survey of the Solifugæ of South Africa" (Ann. Transvaal Mus., vol. vii., part 1, 1919), in which clear generic and specific diagnoses are illustrated by structural drawings and by a series of excellently reproduced photographs. E. A. McGregor's paper on the "red spiders" (Tetranychi) of America (Proc. U.S. Nat. Mus., vol. lvi., 1919) is another recent arachnological publication of importance.

A CONTRIBUTION of importance to Cetacean embryology has been made by Dr. F. E. Beddard, who describes (Ann. Durban Mus., vol. ii., part 4, 1919) two embryos of the sperm whale of an earlier stage than has hitherto been observed. The smaller, measuring only 114 mm. in length, has the relatively short head flexed ventralwards, so that its long axis is almost at right angles to that of the body, while the lower jaw projects beyond the upper; the tail-fin is narrow and ovate in form.

IN a memoir on "The Theoretical Determination of the Longitudinal Seiches of Lake Geneva" (Edin. Roy. Soc. Trans., vol. lii., 1920, pp. 629–42), Messrs. Doodson, Carey, and Baldwin have applied Proudman's general solution (Lond. Math. Soc. Proc., vol. xiv., p. 240) to the particular case of Lake Geneva. The dimensions of the lake along thirty-one sections being obtained from Hornlimann and Delebecque's map, the durations of the first three periods were found to be 74·45, 35·1, and 28 minutes. According to Forel's observations (with a slightly different zero-plane), the period of the uninodal oscillation is 73·5 minutes, and of the binodal oscillations 35·5 minutes. The positions of the nodes of the uninodal and binodal oscillations are also determined theoretically, and agree approximately with those found experimentally, although, as the authors remark, the exact determination of nodes by observation is very difficult. Would it not be possible to test the latter by observing the reflections of the setting sun from the east end of the lake? Three definite reflections were once seen from such a position by the writer of this note.

THE Journal of the Queckett Microscopical Club (vol. xiv., November, 1919) contains an interesting contribution by Dr. Hamilton Hartridge on microscopic illumination, in which the question of the supposed advantages of so-called critical illumination (which consists in accurately focussing an image of

the actual source of light upon the object under examination) is carefully examined. The well-arranged and conclusive experiments described by the author lead to an unconditionally negative answer which will not surprise those who are familiar with the theory of microscopic image-formation, but the results, being experimental, may put an end to the barren discussions on this subject by practical microscopists. A very neat and compact arrangement for the efficient and perfectly controlled illumination of objects in accordance with the results of the investigation is described. Some of the theoretical views in the first part of the paper are not acceptable. Whilst it is true that the usual methods of illumination do not strictly realise the assumptions underlying Abbe's theory, it is surely not open to question that the *theoretical* work and the rare *theoretical* calculations of images have always been carried out in accordance with the theory. The statement that if the ideals of critical illumination were realised, then resolution would be destroyed, is quite untenable, for as that ideal is to make the object behave as if it were self-luminous, the statement amounts to claiming that a self-luminous object—say a white-hot one—could not give a distinct image, which is absurd.

WE have received the fourth report (for 1916) of the seismological observations at De Bilt, Holland (Konink. Nederl. Meteor. Inst., No. 108, 1918, pp. 1–102), in which are given full details of the records obtained from horizontal motion seismographs of Galitzin and Wiechert and a pair of Bosch horizontal pendulums, as well as a summary of the results from other observatories of the more important earthquakes. From this report we learn that the munitions explosion at Faversham on April 2, 1916 (see NATURE, vol. xcix., 1917, p. 250), was registered by the Wiechert and Galitzin pendulums at De Bilt. The effects of the air-waves of this explosion were widely manifested in Holland, especially in the western districts, by the shaking of doors, windows, and pictures, as if by a slight earthquake.

ONE of the strongest earthquakes felt in Porto Rico since the European occupation occurred on October 11, 1918, the official Report of the Earthquake Investigation Commission (Washington, 1919), by Prof. H. F. Reid and Mr. S. Taber, having recently been published. The approximate position of the epicentre is given as 18° 30′ N. lat., 67° 20′ W. long., in the north-east portion of Mona Passage, and the time of occurrence, within a very few seconds, at 2h. 14m. 38s. p.m. (Greenwich mean time). The earthquake was followed after a few minutes by a sea-wave which reached a height of about 4½ metres above mean sea-level along the north-west coast of Porto Rico, the first movement of the water, wherever seen, being one of withdrawal. The epicentre lies along a deep submarine valley, the slopes of which are so steep that they must be regarded as the result of faulting. During the last half-century the north-west coast of the island has been noticeably subsiding, and the authors attribute the earthquake and sea-wave to a vertical displacement near the head or on one side of the submarine valley.

Our Astronomical Column.

ECLIPSE OF THE MOON.—There will be a total eclipse of the moon on the night of May 2–3. The following are the Greenwich times of the various stages :—

Moon enters penumbra	...	May 2,	10.49 p.m.
Moon enters shadow ...	...	,,	12.0 mid.
Beginning of total eclipse	...	,, 3,	1.15 a.m.
End of total eclipse ...	...	,,	2.27
Moon leaves shadow	...	,,	3.41
Moon leaves penumbra	...	,,	4.53

At Greenwich the moon rises on May 2 at 7.5 p.m. and sets on May 3 at 4.34 a.m. The whole of the phases of the eclipse will thus be visible.

During some lunar eclipses the disc of our satellite has remained fairly bright, while at others it has been scarcely visible. If atmospheric conditions are favourable, observations of the character of the shadow on this occasion might be made and, possibly, photographs taken. During the lunar eclipse of July 4, 1917, observations made at the Bordeaux-Floriac Observatory showed that throughout totality the north edge of the moon seemed brighter than the south.

MARS AND WIRELESS SIGNALS.—It is regrettable that in these days, when results of great interest concerning solar and stellar physics are continually being reached, the public should have its attention concentrated upon sensational assertions, such as the Porta planetary scare last December and the suggestion of wireless signals to or from Mars which is now under discussion in the daily Press. Leaving aside the physical difficulties of such communication—which, though considerable, are perhaps not insuperable—a very little consideration suffices to show the utter improbability, closely approaching to impossibility, that the idea of signalling should be mooted simultaneously on the two planets. On any view as to the development of the planetary system, the periods when Mars and the earth pass through corresponding stages would be likely to be separated by millions of years. The suggestion that the Martians have kept up the practice of signalling at every opposition through such a period as this, in the patient hope that they might one day be answered, makes too strong a demand upon our credulity.

THE APRIL METEOR SHOWER.—The weather was moderately fine at the time the Lyrids were expected, and a fair number of them were visible. The best night seems to have been that of April 21, when the sky was generally clear and the maximum abundance occurred near midnight. The phenomenon was observed by Miss A. Grace Cook at Stowmarket, Mr. S. B. Mattey at Plumstead, S.E., Mr. C. P. Adamson at Wimborne, Mr. W. F. Denning at Bristol, and others. The Lyrid meteors formed about one-half of the total number visible on the nights of April 19, 20, and 21, and nearly all of them left streaks. They moved with moderate velocity, being decidedly slower than either the Leonids or the Perseids. As regards brightness they were much above the average, and some fine ones were recorded on the dates mentioned.

THE WASTING OF STELLAR SUBSTANCE.—This is the title of a paper by Prof. F. W. Very in *Scientia* for April. It will be remembered that Prof. Eddington made the suggestion in the *Observatory* last September that the immense duration of the radiation from the stars might be explained by the annihilation of some of their component atoms through collision, and the consequent liberation of their stores of energy.

Prof. Very states that he made a similar suggestion many years ago. He conjectures that great gaseous nebulæ, such as that in Orion, are the synthetic laboratories where matter is being built up; he applies the idea to the Russell sequence of giant and dwarf stars, supposing that the loss of mass (contrary to Prof. Eddington's suggestion) is a large fraction of the whole initial mass, so that the dwarfs, on his view, are stars not merely of smaller diameter and greater condensation, but also of small mass. The increase of velocity with advance of spectral type would thus receive an explanation.

Map-making in India.

THE Report for the year 1915–16 (vol. x.) of the Records of the Survey of India (printed at the office of the Trigonometrical Survey, Dehra Dun, 1917), which has lately come to hand, is somewhat belated. The price of it alone would indicate this, viz. "four rupees or 5*s*. 4*d*."; which does no justice to the present value of the rupee. It is in other respects a new departure. There is no preface, and we look in vain for the usual summing-up of the scientific results of the year's work by the Surveyor-General, Sir Sidney Burrard, who, for that matter, has ceased to direct the Department and retired to a well-earned rest. On the whole, it is a dry record of useful progress in the work of map-making, supplemented by long tables of the results of scientific observation, which surely, if they are of any use at all, should be published in such an up-to-date form as to compare readily with the work of other observers elsewhere whose researches may lead them into the same scientific fields. There is no narrative or detail explanation showing how the results recorded have been attained; no excursions into the realms of geography to lend a flavour of romance to the volume; and no new theories or startling discoveries to save it from the familiar atmosphere of dry official dullness. It is, of course, not meant to be amusing, but it might easily be made more interesting. One unusual and redeeming feature it does indeed contain. There are seven most excellent photogravure portraits of those gallant officers of the Department who fell in the service of their country. They are so good that one cannot but hope that they exist otherwise than in this official environment, and have already become a permanent and honourable feature in the headquarters' offices of the Indian Survey.

The actual progress of mapping for military purposes under the difficult conditions of the war period, when so many men were absent on duty in the fields of France, Mesopotamia, and elsewhere, appears to have been most satisfactory during that busy time. The Punjab surveys extended into Kashmir, and included a great deal of revision on the one-inch scale as well as certain areas on four inches to the mile. This feature of variety in the scale of mapping is common to all the topographical parties, and is a most encouraging sign that the scale is now adapted to the quality of the district surveyed far more freely than used to be the case. Formerly, there is no doubt, much money was wasted over unnecessarily large scale work in districts which had no possible military significance and not much geographical importance in any sense. Practically the topographical surveys are scattered all over India, from the Punjab to Madras and Burma. An examination of cost rates is interesting, for it does not indicate that the cost has greatly altered during the last twenty years. Here again everything depends on the physical characteristics of the district. From 7·6 rupees per square mile in the Punjab (almost entirely revision) to 50·7 rupees in Burma is certainly a most reasonable outlay for the work of the one-inch class, especially when compared with the enormous costs of European mapping on the same scale. The two-inch-per-mile surveys were a trifle more costly (when compared with previous years) than usual, but the surveyors had to face special difficulties in the shape of large areas of dense forest growth.

There is no record of any extension of first-class triangulation, and the scientific branch of the Survey Department seems to have been directed towards the completion of "fore and back double levelling of precision" in the Punjab and the United Provinces, together with the usual programme of tidal and magnetic observations. It is interesting to note the generally increasing accuracy of tidal predictions, although certain errors seem to require explanation. For instance, there were five predictions at Moulmein which were more than thirty minutes wrong. Why? The tabulated magnetic results show that great disturbances occurred in 1915, particularly in the month of June; and on August 29, 1916, the seismograph was dislocated by the violence of its action in recording an earthquake shock. The report, however, says nothing as to the probable location of that shock. It would be interesting to know more about it. An ingenious instrument for calculating attractions, which the designer, Mr. J. de Graaff Hunter, calls an "integrator," is illustrated by photogravure in the report, and this is indeed the one new feature in it which will probably attract most attention from men of science.

The final record of publications by the Survey of India can be best studied by an examination of the index charts which form the appendix. Progress with the 1/M (one-millionth) Maps of the World Series is very satisfactory. It is this class of geographical mapping which has formed the basis for the Peace Conference boundary delimitations, and in their preparation India is working hand-in-hand with the Royal Geographical Society and the Geographical Section of the War Office.

Vol. xiii. of the Survey of India Records, which is issued as supplementary to the general report of 1917–18, brings the topographical records of the Department to a later date than the above. It deals with the same distribution of parties working on original, revision, or supplementary surveys in much the same fields, and denotes good progress at reasonable rates, but for purposes of comparison a more detailed summary is wanted of the amount of survey completed in each class and a few notes on its character and cost by the Officiating Surveyor-General, Col. Ryder, R.E. The geodesic and scientific operations are summarised in part ii., and in the appendices will be found useful reprints from the Journal of the Royal Geographical Society (March and October, 1918) on the problem of the Himalayan and Gangetic troughs, containing the views of such scientific experts as Sir Sidney Burrard and Mr. R. D. Oldham on this most interesting subject. A feature in the report which attracts attention is the distribution of Survey detachments (with the consequent weakening of field parties) amongst artillery practice camps, presumably for the same purpose of range determination as that which absorbed such a large and expensive staff of surveyors under R.E. direction during the later years of the war. This leads one to ask whether the gunners could not be trained to carry out such special surveys for themselves.

T. H. H.

Melanism in British Lepidoptera.

MELANISM has long been a subject of special interest to British entomologists owing to the rise and spread of melanic varieties in many British species of moths and butterflies, such groups as the Geometridæ showing many examples. Records of melanism go back at least to 1850, when the dark variety *Doubledayaria* of *Amphidasys betularia* appeared near Manchester. It afterwards spread until it became the prevalent or exclusiye form in Lancashire and the Midland Counties, extending also to the Continent in later years. The earlier naturalists' point of view (as represented by the writings of Tutt and of Porritt) concerning its causation, related it to the progressive darkening of the background in the neighbourhood of cities as a result of industrialisation. When this explanation was found to be inadequate, moisture was added as a cause of melanism; and Tutt concluded that moisture would darken the surfaces of rocks in rural districts just as smoke darkens surfaces in urban areas, natural selection progressively favouring darker forms which habitually rested on such darkened backgrounds.

In a recent consideration (*Journal of Genetics*, vol. ix., No. 3) of melanism, based on extended observations and breeding experiments in Yorkshire, Mr. J. W. H. Harrison discards the older hypothesis and proposes a new one. This is based on a modification of the insect's metabolism by its feeding upon substances more or less impregnated with chemicals derived from the smoke. It is pointed out that certain melanic areas, such as the vicinity of Middlesbrough, Newcastle-upon-Tyne, and Moray Firth, are among the driest in the country, having a rainfall of 25–28 in. Also, in such species as *Boarmia repandata* and *Oporabia dilutata* the melanic varieties are confined to the towns, while the type occurs in the surrounding country. The melanic forms of different districts, moreover, differ from each other, showing that they have originated locally and irrespective of each other.

Observations showed that an increase in melanism was accompanied by a striking decadence of cryptogamic plants, especially mosses, liverworts, and lichens, many species having quite disappeared from affected areas owing to smoke contamination. This effect on vegetation, and also the degree of melanism, is found to diminish as one leaves the town.

Mr. Harrison compares melanism to such a condition as alkaptonuria in man. The latter condition is known to be inherited, and may be considered a chemical mutation in which the alkapton is not decomposed owing to the absence of a certain enzyme. He suggests that the taking in with the food of small quantities of such salts as KCl, NaCl, and $MnSO_4$ present on the foliage in urban areas would lead to an increase in the amount of tyrosinase present, and so to an increased deposition of melanin, since the activity of various enzymes is increased by the presence of small quantities of these salts. The same interpretation is extended to melanic forms on coasts and islands, where the vegetation is impregnated with similar salts from the sea spray.

It is known that in many cases melanic varieties behave in inheritance as simple Mendelian dominants to the type (*e.g.* Onslow, *Journal of Genetics*, vol. ix., No. 1, on the melanic variety of *Boarmia* (*Tephrosia*) *consonaria*). In crosses with species of Oporabia, however, the author obtained a blend which remained true for two generations, and is interpreted as a gametic blend, the melanism being of a perfectly continuous type. Also, when the hybrids between *O. autumnata* and *O. filigrammaria* were crossed back with the parent forms, a blend resulted. In the F_3 of the cross, however, a "pseudo-segregation" was observed, which is likened to the behaviour in *Oenothera Lamarckiana*. Many writers have suggested such a relation between hybridisation and mutation.

In this interesting and manifold study the author has discarded an original anti-Lamarckian bias, and concludes that various cases, such as the food instincts of *O. filigrammaria* and the period of emergence in a pinewood race of *O. autumnata*, are only explicable as true Lamarckian effects. Natural selection is believed to lead to the genesis of local races, "limiting the range of variation by the elimination of genetical strains less protected in any given habitat."

The haploid chromosome numbers are determined for *O. dilutata*, *autumnata*, and *filigrammaria* as 30, 38, and 37 respectively, and the behaviour of the chromosomes in meiosis furnishes a basis for a further interpretation of the hereditary phenomena.

University Developments at Manchester.

THE University of Manchester is appealing for the comparatively small sum of 500,000*l.* in order to enable it to maintain its present activities effectively and to develop new features. These embrace not only additional buildings and equipment urgently required for the extension of the School of Medicine, especially in the departments of pharmacology and pathology, and for advanced scientific study and research in other important spheres of the University's many-sided work, but also a large increase in the professorial staff, including new professorships in social and political science, physiological chemistry, law, mathematical physics, and French. The present Department of Commerce, established in 1904, is stated to be hopelessly inadequate to the needs of a great commercial centre such as that of south-east Lancashire, and demands, if it is to serve its purpose worthily, a considerable strengthening of its teaching staff. The University has recently established a new degree, namely, the doctorate in philosophy (the Ph.D. degree), granted upon a course of advanced study and research, which will necessarily involve a large expenditure in staff and equipment.

The University is committed to an expenditure of a sum of 171,000*l.* in respect, among other items, of the building and equipment of the new arts building, where it is intended to house the subjects of languages, literature, history, and philosophy, the endowment of new chairs, the reconstruction and equipment of scientific departments, and the provision of women's hostels. It is further contemplated to set up a wide extension of extra-mural teaching so as to bring the influence of the University more closely in touch throughout its wide area with the needs and aspirations of working people by means of extension lectures and systematic three-year evening courses of tutorial classes.

Already in response to the appeal of the University a sum of about 160,000*l.* has been raised, and it ought not, having regard to the population and wealth of the area the University serves, to be difficult to secure the desired sum, and even more. With the view of inducing a large number of people of small means to participate in the effort to raise the money required, a novel scheme has been launched in the form of a prospectus, such as that issued on behalf of limited liability companies, entitled "Lancashire Development, Unlimited, The University of Manchester," inviting subscriptions for new capital to the extent of 500,000*l.*, divided into 425,000 cumulative participating bonds of 1*l.* each and 1,500,000 people's

bonds of 1s. each, the interest upon which will be found in the enrichment of the whole life of the people served by the work of the University. The faculty of technology carried on in the Municipal College of Technology is also issuing an appeal for 150,000*l*., more than half of which has already been subscribed, for the extension of its building and for new equipment. The great and lasting benefit of the work of the University ought to rouse the active sympathy of the numerous municipalities and district councils, together with that of the County Council itself, and to induce these bodies to levy a rate which, if as low as ½*d*. in the pound, would annually produce a sum equal to the interest upon the half-million it seeks to raise.

Courses on the History of Science.

GERMAN and American universities long ago recognised the importance of the history of science as a subject of academic study. In British universities the subject is only just beginning to receive attention. In the University of London last year the Faculty of Arts passed a resolution in favour of including the history of science among the subjects for the B.A. degree, and, although the Senate has not yet dealt with the question, the inclusion of the subject in the curriculum for the new diploma in journalism has helped to advance matters. University College undertook to provide the necessary courses. During the first and second terms of the session 1919–20 Dr. Wolf delivered a course of elementary lectures on the general history and development of science until the end of the eighteenth century. During the present (summer) term Sir W. H. Bragg and others will deal with the history of physical science during the nineteenth century, and Dr. Singer will lecture on the history of medicine. A more elaborate programme will be provided next session. Sir W. H. Bragg and Dr. Wolf will repeat their courses, Prof. J. P. Hill and Dr. Singer will deal with the history of the biological and medical sciences, Prof. Filon will lecture on the history of astronomy, and Mr. Wren on the history of mathematics. The history of other sciences will also be dealt with as opportunity offers.

The primary aim of the elementary courses on the history of science is to provide an essential part of the history of culture. The modern treatment of history is marked by the attention paid to the daily life and habits of the people, as well as to the romance of Court life and the adventures of warriors. The kind of houses which our forefathers inhabited, the kind of dress they wore, and similar matters are receiving due attention in order to fill in the historic picture. All this is as it should be, but the picture can scarcely be complete without the realisation of the mental make-up of the ages, especially so in view of the important *rôle* played by scientific ideas in carrying forward the torch of civilisation.

Over and above its value as an essential part of human history, a course on the history of science should also have the moral and disciplinary value of inculcating a scientific frame of mind—the kind of attitude on which the future of mankind will depend more than ever now that the age of faith seems to be a thing of the long ago.

Such are some of the benefits that may be expected even by those who are not, and do not intend to be, scientific workers, to say nothing of the scientific knowledge which even such students are bound to acquire in following an elementary course on the history of science. More advanced courses for scientific students can scarcely fail to confer the additional advantage of illuminating the methods and results of the makers of science, and so stimulating the latent originality of the student of science.

Marine Biological Structures and Functions.

VOL. XIII. of Papers from the Department of Marine Biology of the Carnegie Institution of Washington, which has lately reached us, contains some contributions of considerable interest. Dealing with gland-cells of internal secretion in the spinal cord of the skates, C. C. Speidel describes large irregular cells of peculiar structure present to the number of some hundreds in the anterior horn. The nucleus is lobular and branched, and the cytoplasm of the resting cell is homogeneous, but in active stages granules of a protein substance are formed in it and discharged into the tissues of the spinal cord, where they persist for some time. These cells develop from neuroblast tissue, and cells homologous with them have been found in various other fishes. The author discusses their function, and concludes that they are gland-cells of internal secretion. He is unable to find that they are necessary to the life of the skate, or to show what their function may be. In a paper on the spermatophores of *Octopus americana*, G. A. Drew shows that these structures, while they are built on a similar plan to those of the squid, are adapted to act quite differently, being less complicated, under less tension, and suited for less rapid service, in correspondence with the less active life of the species. H. L. Clark finds in the distribution of littoral Echinoderms of the West Indies evidence of a much closer relationship between that region and the western coast of tropical America than between it and the Mediterranean, while the fauna of Tobago contains an element derived from the Brazilian coast. Studies on the chemistry of light production in luminous organisms by E. N. Harvey reveal that the substance formerly called photophelein by that author includes two bodies, one—luciferin—oxidisable by luciferase with production of light and formation of oxyluciferin, which can again be reduced to luciferin, the other—protophelein proper—assisting in the promotion of the luciferin-luciferase reaction. E. W. Gudger describes the ovary of *Felichthys felis*, the gaff-topsail catfish, the male of which carries the eggs and larvæ in his mouth.

The Propagation of Flame in Gaseous Mixtures.

ALTHOUGH the large-scale experiments for which the Home Office Experimental Station at Eskmeals was designed have been discontinued since the outbreak of the war, the laboratories have continued to do good work under the direction of Dr. R. V. Wheeler, the chief chemist. In addition to Dr. Wheeler's own researches on the initiation of flame and its propagation through gaseous mixtures, Mr. W. Payman, a member of his staff, has recently published in the Journal of the Chemical Society a series of papers on the propagation of flame in complex gaseous mixtures (vols. cxv. and cxvii.).

Mr. Payman has determined the upper and lower "limits" of methane that will just propagate a flame along a horizontal glass tube 2·5 cm. in diameter when mixed with an atmosphere containing oxygen and nitrogen in which the oxygen varies from 13·7 to 100 per cent. He finds the speed of such flames

almost identical, on the average 20 cm. per sec., the highest speed being measured when the oxygen was 21 per cent. as in air. The same speed was found for the "lower-limit" mixture of all the other paraffin vapours up to pentane when mixed with air.

The "lower-limit" speed of carbon monoxide is also the same, but with hydrogen and air the speed at the lower limit is much slower (10 cm. per sec.), probably on account of the small size of the flame, which does not nearly fill the tube, though it travels to the end.

Mr. Payman next measured the speed of the uniform rate of the hydrocarbons from methane to pentane (when added in different proportions to air) along the same horizontal glass tube. The fastest uniform rate for methane was given by the mixture containing 9·52 per cent. of methane, viz. 66·6 cm./sec. For propane, butane, and pentane the fastest rate was in each case between 82 cm. and 83 cm. per sec.

Then, by mixing together mixtures of the several paraffins which had the same speed, it was shown that all the mixtures had the same speed except just near the maximum or the extinction point, and this gives us a simple means of calculating the values for any combination of paraffins in air.

In a third paper the speeds of the uniform movement in mixtures of carbon monoxide and air are recorded. The rate increased as the amount of water-vapour rose, *e.g.* when a mixture in equal volumes was saturated with steam at 10° C. The rate was 60 cm./sec., and when saturated at 17° C. 79 cm./sec. The mixture in equal volumes also gave the quickest speed at constant temperature, although the percentage for complete combustion is only 29·5 per cent. The uniform speeds for different mixtures of carbon monoxide with hydrogen and with methane were also determined and compared with the calculated speeds.

In the concluding paper Mr. Payman describes his experiments on the uniform rate of flame in mixtures of methane and of hydrogen with atmospheres richer in oxygen than ordinary air. When methane is mixed with pure oxygen the mixture which gives the fastest initial rate is the theoretical mixture for complete combustion with 33 per cent. of methane to 66 per cent. of oxygen; whereas in the propagation of the explosion-wave the fastest mixture is that in which the gases are in equal volumes. Although the uniform movement of flame in the mixture containing 33 per cent. of methane is faster than that in a mixture containing more methane, the author's photographs show that the explosion-wave is more quickly set up in the latter. The abrupt physical change in the mode of propagation seems to be accompanied by an abrupt change in the chemical reaction.

These papers form an interesting contribution to our knowledge of the propagation of flame by "conduction."

University and Educational Intelligence.

EDINBURGH.—His Majesty the King has graciously consented to lay the foundation-stone of the University buildings on the new site of 115 acres at Craigmillar on the occasion of the Royal visit to Edinburgh in July next.

Acting on the recommendation of a special committee recently appointed to consider the question of the German chair, the University Court has resolved that no person be appointed professor of German who is not of British nationality and British parentage, and that, in view of the special circumstances of the case, no appointment to the chair be made at present, but that the present lecturer be retained.

Dr. G. L. Malcolm Smith has been appointed as whole-time assistant in clinical medicine, and Mr. John Anderson as lecturer in logic and metaphysics.

Dr. Robert Kidston has presented to the geological department a collection of Mesozoic fossil plants. The forestry department has received from the Director of the Royal Scottish Museum, on loan, a collection of forestry exhibits, and from the Forest Research Officer of the Federated Malay States and the Chief Conservator of Forests, Dominion of Canada, prepared samples of commercial woods peculiar to these countries.

PROF. H. J. W. HETHERINGTON, of the University College of South Wales, Cardiff, has been appointed to the principalship of Exeter University College in succession to Mr. A. W. Clayden, resigned.

NOTICE is given by the Royal College of Physicians of London that the next examination for the Charles Murchison scholarship in clinical medicine will be held on Monday, June 14, and following days. The scholarship is of the value of twenty guineas, and tenable for one year. Intending candidates must send their names and other specified particulars by June 1 to the Registrar of the College, Pall Mall East, S.W.1.

AT the request of the Ministry of Labour, and with the co-operation of the Rubber Growers' Association, a six months' course of training in the appropriate sciences has been arranged at Birkbeck College to enable ex-Service men to obtain the requisite knowledge to fit them for positions on the great rubber and tea plantations. The course includes training in chemistry, botany, geology, entomology, and simple mechanics, with some knowledge of the care of machinery and book-keeping.

THE League of Nations Union is organising a summer school, to be held at Kempsey School, near Worcester, from Saturday, July 31, to Saturday, August 7. The school is open to both men and women. Applications for admission, which will be considered in the order in which they are received, must reach the League of Nations Union, 22 Buckingham Gate, S.W.1, by June 15. The main object of the summer school is to train those likely to make efficient leaders of study circles.

THE London County Council will shortly proceed to the appointment of the principals of its first group of twenty-two compulsory day continuation schools to be established under the Education Act, 1918. These appointments will be the first of their kind in London, and will be of more than ordinary interest. The type of pupil to be dealt with is one that hitherto has, for the most part, failed to take advantage of educational facilities after leaving the elementary schools. The Act makes great demands on the commercial and industrial world, and it will devolve on the principals of these schools to cultivate close relations with business men and employers, and to secure their cordial co-operation. The success of this great new experiment in national education depends in considerable measure on the sympathy and assistance of the business world. The position of principal will require of its holder administrative ability, good scholastic attainments, and marked personality. The outside-school activities will have to be fostered in every way, so that, with shorter hours of labour, the increased leisure may be utilised to the fullest profit, not only of the individuals, but also of the community. The work should make a strong appeal to those interested in the social welfare side of education. Advertisements inviting applications for these positions are now appearing in the public Press, and forms of applica-

tion can be obtained from the Education Officer (T/3), L.C.C. Education Offices, Victoria Embankment, W.C.2.

THE MARQUESS OF CREWE, chairman of the governing body of the Imperial College of Science and Technology, was present, with other distinguished guests, at the ninth annual dinner of old students of the Royal College of Science on Saturday last, April 24. Sir Richard Gregory, president of the Old Students' Association, who occupied the chair, in proposing the toast of the governing body, said that the time had come for a national survey of the conditions and requirements of university and higher technical education in this country, so that a comprehensive view could be taken of the problem as a whole, existing deficiencies discovered, and adequate educational facilities provided in all areas. The Imperial College would take an important place in any national scheme which might result from such a survey. Lord Crewe, in responding to the toast, said that the college was not content to be merely a school of any university, however distinguished. Though there was in this country no precedent for a technical university, there was, on the other hand, none for a population of eight millions, which was the population of Greater London, with but one university to serve all purposes. The problem of the reorganisation of the University of London was quite enough in itself, without involving the infinitely more difficult task of trying to combine in some way the activities of the University and of the Imperial College in one entirely unprecedented unit. At any rate, the governors of the Imperial College had made up their minds that the problem had to be solved in a way which assured their practical independence. Sir W. H. Bragg spoke of the increased interest, due mostly to the war, now taken in scientific studies, resulting in overfilled laboratories in university institutions and insufficient instructors. Mr. Herbert Wright gave instances of purely scientific investigations at the college which had proved of great practical value, and Prof. J. C. Philip referred to the steps being taken to provide a worthy war memorial to old students. Prof. H. E. Armstrong, proposing the toast of "The Guests," paid a tribute to the men of science whose work contributed so largely to success in the war; and Sir Richard Glazebrook, in responding, referred particularly to the work of Mr. L. Bairstow, Dr. G. W. C. Kaye, and Mr. F. E. Smith, old students of the college, at the National Physical Laboratory.

Societies and Academies.

LONDON.

Linnean Society, April 15.—Dr. A. Smith Woodward, president, in the chair.—Capt. F. Kingdon **Ward**: Natural history exploration on the north-east frontier of Burma.—R. **Paulson**: Stages in the sporulation of gonidia within the thallus of the lichen, *Evernia prunastri*, Ach. It has for a considerable time been generally accepted that the bright-green spherical gonidium which is common to many lichens, and is referred to in the literature of the subject as Cystococcus, Protococcus, or Pleurococcus, multiplies vegetatively only, while it remains the algal constituent of the lichen thallus. Famintzin (1868), Baranetzki (1868), Woronin (1872), Bornet (1873), and Chodat (1913) state that the gonidia (Cystococcus?) of certain lichens produce zoospores after being isolated from the gonidial layer and afterwards cultivated in, or on, different media. The author has not been able to find that the gonidia of *Evernia prunastri*, and of twenty-three other species of lichens, representing eleven genera, divide vegetatively within the thallus, but in all these cases the reproduction of gonidia was found to be the result of the successive bipartition of the original protoplast of the cell into four, eight, or sixteen separate masses, each of which rapidly develops a cell-wall of its own while within the mother-cell. These daughter gonidia (suppressed zoospores?) ultimately escape as the mother cell-wall becomes diffluent. They exhibit all the characteristics of the parent cell before they are set free.

Royal Anthropological Institute, April 20.—Sir Everard im Thurn, president, in the chair.—R. Grant **Browne**: The races of the Chindwin, Upper Burma. The basin of the Chindwin, in the north-west of Burma, is of exceptional interest to ethnologists on account of the medley of peoples inhabiting it—peoples distinguished from each other by their language and customs rather than by their physical characteristics. They include Burmans, Shans, Tamans, Chins, Nagas, Kachins, and Kadus. These terms denote communities rather than races, for the inhabitants may change from one group to another in the course of a few years. The people of Maukkalauk, for instance, are now regarded as Kachins, but have learnt Shan, and will, no doubt, "become" Shans like their neighbours, and eventually Burmans; but their head-man says they left Assam, where they wore white clothes and spoke some language, of which they have forgotten even the name, when his father was a boy. In contrast to this process of assimilation there are mountain tribes living a few miles apart from each other whose dialects have been differentiated until they have become mutually unintelligible. The more civilised communities owe their language and customs to a succession of dominant races. The Burmese came last. Before them were the Shans, and before these probably the Kadus. There are signs that Kadu, now almost extinct in this area, was once the prevailing language of the riverine tracts.

Royal Meteorological Society, April 21.—Mr. R. H. Hooker, president, in the chair.—**Royal Observatory, Greenwich**: A night sky recorder. The object of the instrument is to supplement the daily sunshine record in so far as it gives an indication of the amount of cloud. The instrument consists of a small camera in a fixed position pointing to the pole of the heavens. The lens is a single component of a doublet of 8-in. focal length and 0·4-in. aperture, working at *f*/20. It is found that the aperture, in conjunction with plates of "ordinary" speed, will give a good record even at full moon. Measurements are made by means of a photographic scale.—Lieut. N. L. **Silvester**: Local weather conditions at Mullion, Cornwall. The author gave a detailed analysis of the local meteorological elements in the order of their importance relative to airship navigation, but remarked that the period under review (approximately one year) was too short to deduce much information of climatological value, though during most of this period the observations were as full and as frequent as the changes of the Service in war-time would permit. Ratios of gradient to surface wind had been computed and analysed from the results of more than 400 pilot-balloon ascents by the one-theodolite method. There was evidence of the marked friction and turbulence affecting the wind near the surface in the vicinity of large buildings, such as airship-sheds. Much useful information relating to the local occurrence of fogs and of unusual visibility had been tabulated; whilst another feature was the collection in tabular form of local signs of approaching bad weather, which should prove of value to the local forecaster.—J. E. **Clark**: The Surrey hailstorm of July 16, 1918. This storm differed from other similar British visitations by the

fortunate absence of much wind and by coming after midnight. The track of serious damage rarely exceeded ½ mile in width and was 16½ miles long, the hail beginning at 1.55 a.m. west of Holmwood Station and ending near North Bromley Station, twenty-two miles to the north-east, at about 2.30 a.m. (true time).

EDINBURGH.

Royal Society, March 15.—Prof. F. O. Bower, president, in the chair.—Capt. T. Bedford **Franklin**: The effect of weather changes on soil temperatures. In comparison with the variations of surface temperature, the regular pulsations of temperature in the soil follow well-known laws for amplitude and retardation according to depth, but in these regular pulsations there are fluctuations which occur according to the weather and the state of the soil. If the ratio of the ranges of temperature at the 4-in. depth and the surface be taken as the standard for measuring the heat transfer in the soil, it is found that in a light loam soil this range-ratio varies between 0·19 and 0·42 when active percolation is not taking place in the soil, and between 0·42 and 0·85 when rain is actually falling or during those long-period weather changes associated with the passage of depressions north of these islands, whether rain falls or not. Heat transfer in soil is thus carried out by both conduction and percolation, and a sandy soil that allows free percolation, with consequent high values of the range-ratio, will heat up quicker in spring than a clay soil which takes up and parts with water only sluggishly. Apart from percolation, the high values of the range-ratio in the south-westerly cyclonic type of weather are particularly valuable in causing rapid rises of soil temperature in spring. A surface layer of frozen soil protects the lower depths from rapid changes of temperature; an average surface temperature of −10° C. would be necessary to freeze ordinary soil to a depth of 4 in. in one night. Snow is an even more efficient protection; in November, 1919, the air temperature above 4 in. of snow fell to −15° C. without freezing the soil surface or causing any appreciable fluctuation in the temperature 4 in. beneath the surface of the soil.—D. **Ferguson**: Geological observations in the South Shetlands, the Palmer Archipelago, and the Danco coast, Grahamland.—G. W. **Tyrrell**: A contribution to the petrography of the South Shetlands, the Palmer Archipelago, and the Danco coast, Grahamland.—H. H. **Thomas**: Petrographical notes on rocks from Deception Island and Roberts Island (South Shetlands), the Danco coast, and adjacent islands, Grahamland. These papers contained a great many new facts regarding the geology and petrography of the rocks in the islands named lying to the south of South America. In a broad sense, the geological arrangement might be described as a mirror reflection of the arrangement on the South American coast, and it was probable that the two sets of strata were connected by an arc passing east, and then bending round to the south and to the west, but there was no evidence in support of Suess's theory that this arc extended far to the east so as to include the South Georgian group.—Miss C. W. N. **Sherriff**: A class of graduation formulæ.—Prof. L. **Becker**: The daily temperature curve. In this paper the author developed a new mathematical method of treating the variation of temperature, and illustrated it by a discussion of a forty years' photographic record of temperature in Glasgow.

DUBLIN.

Royal Dublin Society, March 23.—Dr. F. E. Hackett in the chair.—Prof. James **Wilson**: The application of the food-unit system to the fattening of sheep. A summary of experiments in fattening sheep was published by Mr. Herbert Ingle in the Transactions of the Highland and Agricultural Society of Scotland for 1910 and 1911. From this it is evident that the sheep differs from the bullock by being better able to consume roots, and, therefore, less dependent upon hay and straw. The sheep is also considerably more economical as a producer of human food; for, while the well-fed bullock of average size—say 9 cwt.—needs from six to seven food units to produce a pound of beef—a food unit is the quantity of any other food which would have the same producing capacity as a pound of barley—a well-fed sheep of average size—say 120 lb.—produces a pound of mutton on five to six food units.

Royal Irish Academy, April 12.—Mr. W. G. Strickland, vice-president, in the chair.—E. **Heron-Allen** and A. **Earland**: An experimental study of the Foraminiferal species *Verneuilina polystropha*, Reuss, and some others, being a contribution to a discussion on "The Origin, Evolution, and Transmission of Biological Characters." In this paper the authors describe normal and monstrous forms of *Verneuilina polystropha*. The species exhibits characteristic dimorphism in a long, tapering test which is megalospheric, and a short test which is microspheric, but in the dwarf variety, *pusilla*, the tapering test is microspheric. Observations on the selection by Verneuilina of fragments of heavy minerals, by mixing crushed gems with the sand in the experimental tanks with which the authors worked, are described. Variation in the shells of *Massilina secans* is also described in detail, one of the most remarkable "monsters" being a perfectly twinned specimen which had added a curved tube at the junction of the shells to form a common aperture; the whole of this abnormal shell was chitinous. In another case a shell was entirely chitinous except the terminal chamber, which was perfectly and normally calcareous. Further instances of shells combining the characters of two distinct genera—such as have been recorded in former papers by these authors—are given, and the opinion is expressed that the accepted systems of classification of the Foraminifera, founded as they are on the shape and material of the test, must be regarded as largely artificial and unscientific.

PARIS.

Academy of Sciences, March 29.—M. Henri Deslandres in the chair.—G. **Bigourdan**: The observatory of J. S. Bailly at the Louvre.—Prince Albert de **Monaco**: Stray mines in the North Atlantic. A chart is given showing the positions of sixty-eight mines located between November 7, 1918, and February 9, 1920. The predictions by the author in two earlier communications have been fully confirmed.—A. **Rateau**: Some considerations on flight at very high altitudes and on the use of a turbo-compressor. An adverse criticism of a recent communication on the same subject by M. Villey.—P. **Vuillemin**: The growth of fungi discovered in the human nail by Louis Jannin.—G. **Julia**: Families of functions of several variables.—H. **Mineur**: Discontinuous solutions of a class of functional equations.—B. **de Fontviolant**: The strength of circular arches.—F. **Kromm**: A star with a large proper motion. The star B.D.+9·2636°, 9·1 magnitude, has an annual proper motion of nearly a second of arc.—G. **Sagnac**: Newtonian light radiation and the zones of silence in damped wireless telegraphy signals.—M. **Pauthenier**: The ratio of the absolute retardations in Kerr's phenomenon.—M. **Lemarchands**: Study of the reactions of the metallurgy of zinc.

Zinc oxide is reduced by carbon in absence of oxygen (atmosphere of nitrogen) at temperatures between 850° C. and 1100° C. The amounts of carbon used in the reduction of zinc oxide in ordinary metallurgical practice are excessive.—P. **Nicolardot**, A. **Réglade**, and M. **Geloso**: The volumetric estimation of manganese. A study of the errors of Knorr's method.—F. **Gros**: Improvements relating to the commercial production of oxides of nitrogen in arc furnaces. The improvements described are the use of dried gases, increasing the amount of oxygen to 50 per cent., and the replacement of the alkaline absorption towers by a physical method, the separation of the nitrogen peroxide by cooling. The latter can be readily converted into nitric acid of any strength.—A. **Mailhe**: A new method of formation of nitriles by catalysis. Methyl benzoate and ethylamine, passed over alumina heated to 480°–500° C., gave benzonitrile. Paratoluic nitrile, *iso*amyl nitrile, and *iso*butyonitrile were prepared in a similar manner.—L. **Joleaud**: The presence of a Tomistoma in the fresh-water Pliocene of Ethiopia.—F. **Baldet**: The diurnal variation of the atmospheric potential at the Algiers Observatory. A discussion of five years' observations. The diurnal variation is represented by a simple oscillation having a constant minimum about 4 a.m. and a maximum variable with the season. The observations confirm the law of M. Chauveau.—P. **Girard** and V. **Morax**: Liquid exchanges by electrical osmosis through living tissues.—J. **Chaine**: The union of the paramastoid apophysis and of the temporal in mammals.—A. **Krempf**: The oro-aboral metamerisation of the larva of *Pocillopora cespitosa* and of *Seriatopora subulata*.

April 6.—M. Georges Lemoine in the chair.—G. **Rémoundos**: Increasing functions and entire functions.—P. **Humbert**: A new application of the function $W_{k,m'}(x, y)$.—L. E. Z. **Brouwer**: Enumeration of the classes of transformations of the projective plane.—J. **Andrade**: Extension of conservative systems and a generalisation of a theorem of M. Painlevé.—Ch. **Fremont**: Cause of the undulatory wear of rails.—M. **Lecornu**: Observations on the preceding communication.—J. **Villey** and A. **Volmerange**: Hovering flight by a horizontal wind of invariable direction and velocity.—M. **Girousse**: The distribution in the soil of currents from electric traction lines.—P. **Job** and G. **Urbain**: The detection of masked sulphuric ions in complex compounds. The benzidine method of estimating sulphate ions is shown experimentally to possess advantages over the barium method. Examples are given of analyses of cobaltammine sulphates.—Ch. **Boulin** and L. J. **Simon**: The action of water on dichloroethyl sulphide. Using an excess of water at its boiling point, dichloroethyl sulphide can be completely decomposed, giving hydrochloric acid and thiodiglycol; the reaction is reversible.—P. **Fallot**: An extension of the phenomena of drift in the Sierra of Majorca.—G. **Dubois**: The Quaternary fauna of the base of the Ergeron at Cambrai.—L. **Besson**: The actinometers of Arago and Bellani. Details of the precautions necessary in the accurate use of these two instruments.—A. **Piutti**: The action of chloropicrin on the parasites of wheat and on rats. Large-scale experiments have proved the efficacy of chloropicrin in destroying wheat parasites, and it has also been demonstrated that the treated wheat is inoffensive and preserves its nutritive power. Chloropicrin has also been successfully employed in the destruction of rats in ships.—V. **Galippe**: Researches on the resistance of the microzymas to the action of time and their survival in amber.—G. **Bertrand**: The action of chloropicrin upon the higher plants. Under suitable conditions it is possible to use chloropicrin to free a plant from all its leaf parasites without killing the plant.

ROME.

Accademia dei Lincei, February 1.—A. Ròiti, vice-president, in the chair.—G. **Fubini**: Affine differential invariants of a surface.—Q. **Majorana**: Gravitation. This is the seventh note on the author's experimental attempts to detect the screening off of gravitation by massive sheets of matter (see NATURE for April 22, p. 251). The whole note is devoted to the search after, and the discussion of, "causes of error" or disturbing effects. These troublesome effects are now all estimated numerically, but, notwithstanding this, the author closes the present note, postponing the computation of the corrected value of the effect sought for to the next (viii.) note.—V. **Amato**: Kronecker's method for the decomposition of an integral rational function in an amplifield field of rationality.—P. **Scatizzi**: Abelian differential equations reducible to quadratures.—L. **Tonelli**: Primitive functions (ii.).—Clara **di Capua**: Investigations on alloys of Au and Si.—C. **Gorini**: A microbiological investigation of the behaviour of *Bacterium coli* in milk.

L. SILBERSTEIN.

Books Received.

Life of Lord Kitchener. By Sir George Arthur. 3 vols. Vol. i., pp. xxvi+326; vol. ii., pp. xi+346; vol. iii., pp. xi+413. (London: Macmillan and Co., Ltd.) 2*l*. 12*s*. 6*d*. net

Grain and Chaff from an English Manor. By A. H. Savory. Pp. viii+311. (Oxford: B. Blackwell.) 21*s*. net.

The Works of Aristotle. Translated into English. Œconomica. By E. S. Forster. Atheniensium Respublica. By Sir Frederic G. Kenyon. Unpaged. (Oxford: At the Clarendon Press.) 5*s*. net.

The Geography of Plants. By Dr. M. E. Hardy. Pp. xii+327. (Oxford: At the Clarendon Press.) 7*s*. 6*d*. net.

The Ways of Life: A Study in Ethics. By S. Ward. (London: Oxford University Press.) 6*s*. 6*d*. net.

Tungsten Ores. By R. H. Rastall and W. H. Wilcockson. Pp. ix+81. (London: John Murray.) 3*s*. 6*d*. net.

Microscopy: The Construction, Theory, and Use of the Microscope. By E. J. Spitta. Third edition. Pp. xxviii+537+xxviii plates. (London: John Murray.) 25*s*. net.

College Text-book of Chemistry. By W. A. Noyes. Pp. viii+370. (New York: H. Holt and Co.)

Diary of Societies.

THURSDAY, APRIL 29.

OPHTHALMOLOGICAL SOCIETY OF THE UNITED KINGDOM (at Royal Society of Medicine), at 10 a.m.—J. B. Story: Presidential Address.—C. H. Usher: Enlarged Corneæ in Goldfish.—E. Treacher Collins: Megalocornea and Micro-cornea.—J. Rowan: Are not some Cases of Glaucoma Better Treated without Operation, and, if so, what are the Indications?—A. Zorab: Later Notes on Aqueoplasty.—T. Harrison Butler: Notes on Infection after Operations for Cataract.—G. H. Pooley: Abnormalities of the Lacrymal Apparatus and their Treatment.—G. Harvey Goldsmith: A Case of Double-Traumatic Dislocation of the Lens.—G. F. Alexander: (1) A Position of the Head Favourable to the Operation for Cataract; (2) An Operation for Advancement in Strabismus.

ROYAL INSTITUTION OF GREAT BRITAIN, at 3.—R. Campbell Thompson: The Origins of the Dwellers in Mesopotamia.

ROYAL SOCIETY, at 4.30.—Prof. J. W. Gregory: The Irish Eskers.—Miss K. M. Curtis: The Life-History and Cytology of *Synchytrium endobot cum* (Schilb.) Perc., the Cause of Wart Disease in Potato.—B. Sahni: The Structure and Affinities of *Acmopyle pancheri*, Pilger.

ZOOLOGICAL SOCIETY OF LONDON, at 4.30.—Annual General Meeting.

CHEMICAL SOCIETY, at 5.—Extraordinary General Meeting to consider the Alterations in the By-laws proposed by the Council.

CHILD-STUDY SOCIETY (at Royal Sanitary Institute), at 6.—Sir A. E. Shipley: Biting Insects and Children.

INSTITUTION OF ELECTRICAL ENGINEERS (at Institution of Civil Engineers), at 6.—A. E. McColl: Automatic Protective Devices for Alternating Current Systems.

OPTICAL SOCIETY (at Imperial College of Science and Technology), at 7.30.—Dr. C. E. Kenneth Mees: The Reaction of the Eye to Light.

FRIDAY, APRIL 30.

OPHTHALMOLOGICAL SOCIETY OF THE UNITED KINGDOM (at Royal Society of Medicine), at 10 a.m.—Sir Archibald Garrod, R. Foster Moore, and Others: Discussion on Diabetes in Relation to Diseases of the Eye.—At 8.—H. M. Traquair: Anatomically Separate Anterior Commissure at the Chiasma in a Case of Pituitary Tumour with Acromegaly.—Dr. G. Holmes: Tumours Involving the Optic Nerves and Chiasma.—M. L. Hine: Primary Epithelioma of the Ciliary Body.—E. Clarke: A Further Note on the Accommodation of the Eye.—H. Neame: Cysts of the Retina.—W. Wallace: A Glyptic Method for Representing Certain Conditions of the Fundus in Disease.—A. W. Stirling: A Case of Melanoma of the Iris.

WIRELESS SOCIETY OF LONDON (at Institution of Civil Engineers), at 6.—Major B. Binyon: A Wireless "Call" Device.

INSTITUTION OF ELECTRICAL ENGINEERS (Students' Meeting) (at Faraday House), at 7.—J. E. Holmstrom: Tidal Power.

INSTITUTION OF MECHANICAL ENGINEERS (Informal Meeting), at 7.—A. P. Bale and Others: Discussion on Suggested Means of Improving and Increasing the Services of the Institution to Members.

ROYAL INSTITUTION OF GREAT BRITAIN, at 9.—Prof. F. O. Bower: The Earliest-known Land Flora.

SATURDAY, MAY 1.

OPHTHALMOLOGICAL SOCIETY OF THE UNITED KINGDOM (at St. Margaret's Hospital, Leighton Road, Kentish Town), at 10 a.m.—Dr. G. Fitzgibbon, M. S. Mayou, and Others: Discussion on the Prevention and Treatment of Ophthalmia Neonatorum.

ROYAL INSTITUTION OF GREAT BRITAIN, at 3.—Dr. F. Chamberlin: The Private Character of Queen Elizabeth.—At 5.—Annual Meeting.

MONDAY, MAY 3.

ROYAL INSTITUTION OF GREAT BRITAIN (General Meeting), at 5.

SURVEYORS' INSTITUTION (Junior Meeting) (Annual General Meeting), at 7.

ROYAL INSTITUTE OF BRITISH ARCHITECTS (Annual General Meeting), at 8.

ROYAL SOCIETY OF ARTS, at 8.—A. T. Bolton: The Decoration and Architecture of Robert Adam and Sir John Sloane, 1758-1837 (Cantor Lecture).

SOCIETY OF CHEMICAL INDUSTRY (at Chemical Society) (Annual Meeting), at 8.

ROYAL GEOGRAPHICAL SOCIETY (at Æolian Hall), at 8.30.—H. St. J. Philby: Across Arabia: from the Persian Gulf to the Red Sea.

TUESDAY, MAY 4.

ROYAL INSTITUTION OF GREAT BRITAIN, at 3.—Prof. A. Keith: British Ethnology: The Invaders of England.

ROYAL SOCIETY OF MEDICINE (Orthopædics Sub-Section), at 5.—Annual General Meeting.

ROYAL PHOTOGRAPHIC SOCIETY OF GREAT BRITAIN (Technical Meeting), at 7.—Dr. C. E. Kenneth Mees and L. A. Jones: The Theory of Tone Reproduction.

RÖNTGEN SOCIETY (at Medical Society of London), at 8.15.—Prof. S. Russ: Some Problems in the Action of Radiation upon Tissues.—Prof. A. O. Rankine: The Transmission of Speech by Light.—Dr. H. A. Eccles: New Portable Viewing Lantern (Demonstrations).

WEDNESDAY, MAY 5.

ROYAL SOCIETY OF ARTS at 4.30.—Dr. C. E. Kenneth Mees: A Photographic Research Laboratory.

GEOLOGICAL SOCIETY OF LONDON, at 5.30.—S. Hazz'edine Warren: A Natural "Eolith" Factory beneath the Thanet Sand.

ROYAL SOCIETY OF MEDICINE (Surgery Section), at 5.30.—Annual General Meeting.

SOCIETY OF PUBLIC ANALYSTS AND OTHER ANALYTICAL CHEMISTS (at Chemical Society), at 8.—C. A. Mitchell: Estimation of the Age of Ink in Writing.—E. R. Dovey: The Estimation of Chinese Crude Camphor.—H. D. Richmond and L. R. Ellison: Studies in Steam Distillation, Part VII.: The Volatility of Isomers.

INSTITUTION OF AUTOMOBILE ENGINEERS (at Institution of Mechanical Engineers), at 8.—Major B. H. Thomas: The Electro-Deposition of Iron as applied to Motor Vehicle Repair Work.

THURSDAY, MAY 6.

IRON AND STEEL INSTITUTE (at Institution of Civil Engineers) (General Meeting), at 10 a.m.—Dr J. E. Stead: Inaugural Address.—E. H. Lewis: Iron Portland Cement.—At 2.30.—F. Clements: British Blast-Furnace Practice.—H. E. Wright: Chemical and Thermal Conditions in Blast-Furnace Practice.—C. H. Ridsdale: The Valuation of Ores and Iron-making Material.—J. A. Heskett: The Utilisation of Titaniferous Iron Ore in New Zealand.

ROYAL SOCIETY OF MEDICINE (Obstetrics and Gynæcology Section, conjointly with the North of England and Midland Obstetrical and Gynæcological Societies), at 10.30 a.m.—Dr. H. Tweedy and Others: Discussion on The Treatment of Antepartum Hæmorrhage.—At 2.—Dr. E. Holland and Others: Discussion on Rupture of Cæsarean Section Scar in Subsequent Pregnancy or Labour.

ROYAL INSTITUTION OF GREAT BRITAIN, at 3.—R. Campbell Thompson: The Legends of the Babylonians.

ROYAL SOCIETY, at 4.30.—*Probable Papers*: R. H. Fowler, F. C. Gallop, C. N. H. Lock, and H. W. Richmond: The Aerodynamics of a Spinning Shell.—Prof. W. E. Dalby: Researches on the Elastic Properties and the Plastic Extension of Metals.—C. T. R. Wilson: Investigations on Lightning Discharges and on the Electric Field of Thunderstorms.—L. F. Richardson: The Supply of Energy to Atmospheric Eddies.

LINNEAN SOCIETY OF LONDON, at 5.—Dr. G. P Bidder: Notes on the Physiology of Sponges. *Pandorina spongiarum*, a New Species of Alga found in a Sponge.—E. J. Bedford: The British Marsh Orchids and their Varieties, Illustrated by Coloured Drawings and Lantern Slides.

CHEMICAL SOCIETY, at 8.—G. M. Bennett: The Mustard Gas Problem.—C. K. Ingold: A New Method of Preparing Muconic Acid.—J. W. Cook and O. L. Brady: The Dinitration of *m*-Acetotoluidide.—Y. Venkataramayya and M. V. Narasimhaswamy: A New Ozoniser.—G. T. Morgan and H. D. K. Drew: Orthochlorodinitrotoluenes. Part I.

FRIDAY, MAY 7.

IRON AND STEEL INSTITUTE (at Institution of Civil Engineers) (General Meeting), at 10 a.m.—C. A. Ablett: Direct Current compared with Three Phase Current for Driving Steel Works Plant.—J. F. Wilson: Notes on Slag Conditions in Open-hearth Basic Steelmaking Practice.—B. Yaneske and G. A. Wood: The Reduction of Silicon from the Slag in the Acid Open-hearth Process.—At 2.30.—W. E. Hughes: Some Defects in Electro-deposited Iron.—T. Baker and T. R. Russell: Note on the Ball Test.—J. H. Whiteley: The Distribution of Phosphorus in Steel between Points Ac1 and Ac3.—G. F. Preston: Practical Notes on the Design and Treatment of Steel Castings.

ROYAL SOCIETY OF MEDICINE (Laryngology Section), at 4.—Annual General Meeting.

ROYAL ASTRONOMICAL SOCIETY (Geophysical Discussion), at 5.—Prof. R. A. Sampson and Others: The Use of Wireless Telegraphy in the Determination of Longitude.

ROYAL INSTITUTION OF GREAT BRITAIN, at 9.—Lord Rayleigh: The Blue Sky and the Optical Properties of Air.

SATURDAY, MAY 8.

ROYAL INSTITUTION OF GREAT BRITAIN, at 3.—Dr. F. Chamberlin: The Private Character of Queen Elizabeth.

BRITISH PSYCHOLOGICAL SOCIETY (at Bedford College), at 3.30.—Dr. E. W. Scripture: Speech Inscriptions in Normal and Abnormal Conditions.—A. Klein: Camouflage in Land Warfare.

CONTENTS.

	PAGE
The Chemical Industries of German Rhineland	253
Man: Past and Present. By Prof. G. Elliot Smith, F.R.S.	255
Critical Mathematics. By G. B. M.	256
The Proteins	257
Science and Engineering. By W. C. U.	258
Health and the Teacher	259
Our Bookshelf	259
Letters to the Editor:—	
Theories of Atomic Structure.—**Irving Langmuir**	261
Decimal Coinage.—**Harry Allcock**	261
International Council for Fishery Investigations.—**X. Y. Z.**	262
The Plumage Bill and Bird Protection.—**Prof. J. E. Duerden**	263
The Standard of Atomic Weights.—**Prof. J. R. Partington**	264
Mortlakes as a Cause of River-windings. (*With Diagram.*)—**T. S. Ellis**	264
Eiffel Tower Wireless Time-signals.—**Prof. R. A. Sampson, F.R.S.**	265
Some Tests of the 100-in. Hooker Telescope. (*Illustrated.*) By **Dr. George E. Hale, For. Mem. R.S.**	266
Artillery Science. By **Sir George Greenhill, F.R.S.**	268
Obituary:—	
Dr. Rudolph Messel, F.R.S. By **H. E. A.**	270
Prof. A. K. Huntington	271
Dr. A. J. Chalmers	271
Prof. L. T. O'Shea. By **A. McW.**	272
Notes	273
Our Astronomical Column:—	
Eclipse of the Moon	276
Mars and Wireless Signals	276
The April Meteor Shower	276
The Wasting of Stellar Substance	276
Map-making in India. By **T. H. H.**	277
Melanism in British Lepidoptera	278
University Developments at Manchester	278
Courses on the History of Science	279
Marine Biological Structures and Functions	279
The Propagation of Flame in Gaseous Mixtures	279
University and Educational Intelligence	280
Societies and Academies	281
Books Received	283
Diary of Societies	283

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